Martina Koll-Schretzenmayr

Eine Reise in das Reich der Mitte

"This is a country where everything is changing before your eyes, and a visitor can return after a year's absence and be surprised at the transformation". (Logan, 2002: 21)

Während der Vorbereitungen für das Themenheft *Urban and Regional Sustainability in China* haben drei Beobachtungen meine Diskussionen, die ich mit westlichen Kolleginnen und Kollegen führte, die vor Ort in China als Architekten, Denkmalpfleger und Planer gearbeitet haben, wie ein roter Faden durchzogen: Zum Ersten das grosse Erstaunen über den raschen Wandel in China – in räumlicher, ökonomischer und sozialer Hinsicht. Zum Zweiten die kulturellen Unterschiede und die auf der Sprachbarriere begründeten Verständigungsschwierigkeiten. Zum Dritten der Hinweis auf rasche kollegiale Vertrauensbildung als Basis einer fruchtbaren Zusammenarbeit und eines erfolgreichen Erfahrungsaustausches mit den chinesischen Kooperationspartnern.

In den persönlichen Gesprächen bemerkte ich stets die uneingeschränkte Faszination für das Land, aber auch für die planerischen Herausforderungen vor Ort. Obwohl nie explizit ausgesprochen, war unterschwellig immer zu spüren, dass die treibende Kraft für langjährige Kooperationen mit chinesischen Partnern ein «Alles ist möglich, das Unerwartete ist das Wahrscheinlichste» ist.

Mit den Beiträgen in diesem Heft können nur Schlaglichter gesetzt werden – zu gross ist das Land, zu vielfältig sind die regionalen Verhältnisse, zu rasch ist der Wandel und zu umfangreich sind die Herausforderungen. Sehr unterschiedlich ist bei den einzelnen Beiträgen der Betrachtungsfokus, welcher von der Einführung einer Buslinie in Kunming bis zur regionalen Verteilung der ausländischen Investitionen in China reicht. Die unterschiedlichen Brennweiten der Untersuchungsoptik, die zur Anwendung kommen, und die Themenvielfalt, die behandelt wird – von Altstadtschutz bis Transport – bieten aber möglicherweise gerade den besonderen Reiz dieser imaginären Reise in das Reich der Mitte, deren Stationen sich wie folgt gestalten:

Mee Kam Ng gibt einen Überblick über Nachhaltige Entwicklung in der Sonderwirtschaftszone Shenzen im Pearl River Delta, die 2002 mit dem *Global 500 Roll of Honour* des *United Nations Environment Programme* ausgezeichnet wurde. Ausschlaggebend für den Weg Shenzens zur Nachhaltigkeit waren die Entscheidung für ein *garden city Konzept*, der Konkurrenzkampf um ausländisches Investitionskapital und Chinas Agenda 21.

Mark Yaolin Wang untersucht die Frage, welche Auswirkungen die Liberalisierung des Hukou Systems, mit welcher der ländlichen Bevölkerung Ende 2001 eine legale Zuwanderung in Kleinstädte ermöglicht wurde, voraussichtlich auf Chinas urbanes System haben wird.

Sung-Cheol Lee und Kark-Bum Lee untersuchen die regionale Fragmentierung Chinas infolge der ungleichen Verteilung ausländischer Investitionen. Das sich hauptsächlich auf die östlichen Provinzen entlang der Küste konzentrierende Kapital ausländischer Kapitalgeber hat in der Post-Mao-Ära zu erheblichen regionalen Disparitäten geführt.

Jeff Kenworthy und Gang Hu analysieren Chinas Siedlungs- und Transportstrukturen und kommen zu dem Schluss, dass China im internationalen Vergleich derzeit hohe Siedlungsdichten und einen geringen Automobilisierungsgrad aufweist, jedoch in den vergangenen Jahren enorme Zuwachsraten insbesondere im Mobilisierungsgrad und bei Strassenbauinvestitionen zu verzeichnen hatte. Sie weisen auf die besondere Verantwortung der chinesischen Planer und Entscheidungsträger hin, die bestehenden Qualitäten der chinesischen Siedlungsstrukturen zu erhalten und langfristig zu sichern.

Bryn Sadownik und Mark Jaccard diskutieren, wie die Siedlungsform den Energieverbrauch und den damit verbundenen Schadstoffausstoss beeinflusst. Sie setzen ein Modell ein, welches für China zwei alternative Siedlungsentwicklungsszenarien gegenüberstellt. Neben dem Trendszenario wird ein Szenario betrachtet, welches auf das *Community Energy Management* (CEM), das sich unter anderem an Nutzungsmischung, hohen Dichten und Einsatz öffentlichen Verkehrs orientiert, ausgerichtet ist.

Margrit Hugentobler, Beisis Jia, Fred Moavenzadeh und Keisuke Hanaki präsentieren die im Rahmen der *Alliance for Global Sustainability* durchgeführte Forschungskooperation zwischen der ETH Zürich, dem MIT und der University of Tokyo, die zum Ziel hat, in Guangzhou nachhaltige Entwicklung in den Bereichen Transport, Wohnungsbau, Wasserwirtschaft und Nutzungsplanung zu etablieren.

Jacques P. Feiner, Diego Salmerón, Ernst Joos und Willy A. Schmid reflektieren anhand der Erfahrungen, die im Rahmen der seit 1996 laufenden Planungs- und Beratungstätigkeit für den Grossraum Kunming gewonnen wurden, über die Möglichkeiten, im Rahmen einer Städtepartnerschaft Impulse für eine nachhaltige Entwicklung zu initiieren.

Lin Wei und Tang Chong geben einen Überblick über die Erfolgsgeschichte wie auch die noch anstehenden Herausforderungen der ersten Buslinie in Kunming mit separater Busspur, die 1999 anlässlich der in Kunming durchgeführten Weltgartenausstellung eröffnet wurde.

Werner Stutz hat seit Mitte der 1990er-Jahre den Aufbau des Altstadtschutzes in der Stadt Kunming fachlich begleitet und unterstützt. Er berichtet über den Transfer schweizerischer denkmalpflegerischer Arbeitsweisen und Inventarisierungsmethoden, zugeschnitten auf die Verhältnisse und Anforderungen vor Ort in Kunming.

Mit Jacques P. Feiner, Mi Shiwen und Willy A. Schmid verlassen wir am Ende unserer imaginären Reise die Metropolen Chinas und statten dem Shaxi Valley in der Provinz Yunnan, der letzten erhalten gebliebenen Karawanserei eines Seitenastes der Seidenstrasse, einen Besuch ab. Das entlegene Tal am Fusse des Himalaya gibt Einblick in die Problematik des ländlichen Chinas. Das 2001 gestartete *Shaxi Valley Rehabilitation Project* möchte auf der Basis einer umfassenden Regionalplanung gezielt die kulturellen, naturräumlichen und demografischen Potenziale dieses Raumes für eine nachhaltige Entwicklung nutzen.

Martina Koll-Schretzenmayr

Imaginary Journey through China

"This is a country where everything is changing before your eyes, and a visitor can return after a year's absence and be surprised at the transformation." (Logan, 2002: 21)

During the preparations for this issue covering "Urban and Regional Sustainability in China," three observations stood out from my discussions with western colleagues who have shared with me their experiences in cooperating with Chinese counterparts in the fields of architecture, spatial planning, and cultural preservation. First among these is the astonishing speed of change in China from the spatial, economic, and social perspectives. Second, the cultural differences and the communication difficulties arising from language barriers. Finally, the fact that despite the many barriers, relationships of trust did develop leading to successful cooperation and valuable exchanges of knowledge and experience.

Throughout the course of my conversations, I noticed the uniform fascination for the country, but also for its specific spatial challenges. Although never expressed explicitly, it was evident that cooperation with Chinese partners took place under the premise that "everything is possible, and the unexpected is the most probable." The articles in our latest issue can only scratch the surface of the many complex challenges – too large is the country, too diverse the different regional circumstances, too rapid the pace of change and the associated challenges. The focus of each of the articles is also diverse, from the introduction of a bus line in Kunming to the regional distribution of foreign investment. Yet it is exactly the broad spectrum of topics and perspectives that gives our imaginary journey through China its special attraction.

The stations on our journey are as follows:

Mee Kam Ng provides an overview of sustainable development in Shenzen's special economic zone situated on the Pearl River Delta; in 2002 this zone was granted the "Global 500 Roll of Honor" awarded by the United Nations Environment Program. Central to Shenzen's path to sustainability were the decision taken in favor of a garden city concept, the competition for foreign investment capital, and China's Agenda 21.

Mark Yaolin Wang investigates what effects will result to China's urban system through the liberalization in late 2001 of the Hukou system to allow rural inhabitants to migrate to small cities and towns.

Sung-Cheol Lee and Kark-Bum Lee examine the regional fragmentation of China as a consequence of the uneven distribution of foreign investment. The concentration of foreign capital in the eastern coastal provinces has led to significant regional disparities in the post-Mao era.

Jeff Kenworthy and Gang Hu analyze China's settlement and transportation structures and come to the conclusion that China exhibits high settlement concentrations and low levels of motorization in international comparison, but has attained tremendous growth in road construction investments in the last few years. They refer to the special responsibility of Chinese planning officials to preserve the existing qualities of Chinese settlement structures over the long term.

Bryn Sadownik and Mark Jaccard discuss the ways in which different forms of settlement influence energy consumption and the level of polluting emissions. They make use of a model that presents China with two alternative scenarios for settlement development. Next to the trend scenario, the authors point to another scenario based on "Community Energy Management" (CEM), which is oriented toward diversity of use, high settlement concentrations, and public transport.

Margrit Hugentobler, Beisis Jia, Fred Moavenzadeh, and Keisuke Hanaki present the joint research project carried out by the ETH Zurich, MIT, and the University of Tokyo within the framework of the "Alliance for Global Sustainability." The goal of the project is to establish sustainable development in the city of Guangzhou in the areas of transport, settlement construction, and water resource management.

Jacques P. Feiner, Diego Samerón, Ernst Joos, and Willy A. Schmid, all active as planning consultants in the Kunming metropolitan area since 1996, reflect on the possibilities of initiating new impulses for sustainable development within the framework of a city partnership.

Lin Wei and Tang Chong provide an overview of the success story associated with the first center-lane bus line in Kunming, while also pointing to the challenges that still lie ahead.

Werner Stutz has supported the development of city preservation initiatives in Kunming since the mid-1990s. He reports on the transfer of Swiss methods for the preservation of cultural assets and monuments adapted to the specific local circumstances and challenges found in Kunming.

With Jacques P. Feiner, Mi Shiwen, and Willy A. Schmid, we leave the metropolitan regions of China and end our journey in the Shaxi Valley of Yunnan Province, the last remaining caravanserai on an offshoot of the Silk Road. The isolated valley at the foot of the Himalaya provides a glimpse into the problems facing rural China. The "Shaxi Rehabilitation Project," started in 2001, seeks to use the cultural, natural, and demographic potentials of this region within the framework of comprehensive regional planning.

Translation: Martin Gahbauer, Birmingham.

Reference

John R. Logan (2002): Three Challenges for the Chinese City: Globalization Migration, and Market Reform. In: John R. Logan (Ed.): The New Chinese City. Globalization and Market Reform, Oxford.

Jeff Kenworthy, Gang Hu

Transport and Urban Form in Chinese Cities

An International Comparative and Policy Perspective with Implications for Sustainable Urban Transport in China

Chinese cities are acknowledged worldwide as being the leaders in non-motorised transport. Many other aspects of their transport and urban form are also conducive to low levels of automobile dependence. However, urban China is changing rapidly with very high rates of motorisation and a number of policies and factors that are pushing their transport systems towards greater reliance on cars and motor cycles. Development of quality public transport systems appears not to be keeping pace with the emphasis on private transport. This paper briefly explores how Chinese cities compared on key transport and urban form factors to a large sample of other cities from around the world in 1995. It further examines a range of important policies and factors that are shaping Chinese urban transport systems and explores the potential of Chinese cities to embrace the ideal of "sustainable urban transport", as opposed to increasing automobile dependence.

1. Background

With China's economy booming, a question has arisen about whether human life and global sustainability will suffer severe decline if China, the largest country on the earth, were to increase its urban automobile ownership and usage to the current US level (Hook and Ernst, 1999). A planner at one large auto company believes that "there could be 70 million motorcycles, 30 million lorries and 100 million cars in China by 2015" (Hook and Replogle, 1996). "The potential effects of this car explosion – on the quality of human life and the sustainability of all life – are staggering" (Tunali, 1996). Today, transportation accounts for 15 to 20% of the annual 6 billion tons of carbon emissions from human activities that are leading to climate change. By 2030, China is expected to have 828 million city dwellers. If they were to drive as much as the average American, "the carbon emissions from transportation in urban China alone would exceed 1 billion tons, roughly as much as released from all transportation worldwide today" (Worldwatch Institute, 1999). "If China attains its dream of a car for every family, the resulting emissions could increase carbon concentrations to an extent that would affect the entire world and offset emissions reductions achieved in other countries" (Tunali, 1996), and "the implications for global warming and energy consumption are truly harrowing" (Hook and Replogle, 1996). Hook and Ernst (1999) state that: "Because of China's immense population, small changes in assumptions about China's motorisation could throw future global oil demand projections and greenhouse gas emissions estimates off by 100%" (p. 7).

It would be a disaster, not only for China itself, but also for the entire world, if China devastates its physical and social environments in the way that much of the developed world has been doing through its extreme dependence on the automobile. The global and local concerns that lie behind trends in motorisation in China are the motivation for this paper. The research presented here therefore attempts to develop a deeper insight into the scenarios for Chinese urban transport by asking the following key questions:

- What is the current situation in Chinese cities compared internationally to a large sample of other cities, in terms of land-use, transport infrastructure, transport patterns, motor vehicle ownership and usage, transport energy consumption and transport externalities?
- What are the key factors in shaping Chinese urban transport and land-use, and would Chinese cities develop along a path of automobile dependence in a period of rapid economic growth and modernisation?
- How would China integrate its urban development and transport policies in shaping sustainable urban transport and land-use?

2. A Comparative Overview of Land-Use and Transport Patterns in Chinese Cities

2.1 Urban Form and Land-Use Patterns

Before presenting some basic comparative land-use data on Chinese cities, it is necessary to qualify a few issues concerning how to compare Chinese cities with their international counterparts.

2.2 Some Methodological Issues

A useful way of presenting this discussion is to consider the fundamental issue of a city's urban density. Urban density is one of the most important factors in determining a city's level of car use, energy use and the viability of public transport, walking and cycling (Newman and Kenworthy, 1989, 1999). Urban density takes for its denominator the total built-up land (residential, commercial, and industrial land, etc., plus roads and streets). It excludes rural land, forests, large areas of contiguous undeveloped or vacant land, regional scale open spaces, but not local open spaces. Higher urban densities, and the mixed land-uses which are associated with them, shorten the length of trips by all modes, make walking and cycling possible for more trips and create sufficient concentrations of activities for an effective, frequent public transport service (Newman and Kenworthy, 1999; Kenworthy and Laube et al., 1999).

There are some problems in directly comparing Chinese cities with other international cities because of the urban form and some unique definitions in the Chinese statistical system, though in the final analysis these problems do not prevent worthwhile comparisons with other cities. In some ways the problems faced are similar to the urban data collection problems in many western and other Asian cities.

In China, statistical data are collected by administrative units on different levels. By means of administrative division, a typical Chinese city consists of an urban area and several counties which consist of a small or mid-sized city (or central towns), tens of towns and extensive rural areas. The county-level city that is actually an economically devel-

oped county is an exception. The normal statistical representations are therefore "Quian Shi" and "Shi Qu" which refer to "City-Wide Area" and "City Area" respectively. And the "City Area" actually also includes areas of land that are more or less rural in character. This results in some difficulties for research and international comparisons.

Unlike in western cities, suburbs in Chinese cities are mainly rural in the character of their land-uses, with some highly focussed nodes of urban development scattered throughout the rural lands. They don't bear very much relationship to the urban area, either in their residential patterns or the way they are extended. Therefore they cannot generally be regarded as parts of the urban agglomeration. So both "City-Wide Area" and "City Area" are not ideal statistical units, and unfortunately, built-up area is not a recognised administrative unit on which basic data are gathered, even though it is unquestionably much better for research. Under these circumstances, sometimes the only way to do meaningful comparative urban research, is through detailed analysis of existing information which permits some reorganisation of data and educated estimates where necessary. [1]

In summary, although there are particular data specification problems in Chinese cities, these are akin to similar problems in other cities and do not prevent a valid attempt at international comparisons. A full discussion of these methodological issues can be found in Kenworthy and Laube et al. (1999).

City	Estimated population in built-up area 1995 (1,000 persons)	Area of built-up area 1995 (ha)	Density in built-up area 1990 (persons/ha)	Density in built-up area 1995 (persons/ha)
Beijing	6,528	47,700	141	137
Shanghai	7,656	39,000	251	196
Tianjin	4,752	35,900	138	132
Guangzhou	3,083	25,900	157	119
Hangzhou	1,148	9,600	155	120
Ningbo	914	6,200	144	147
Average	4,014	27,400	164	146

Source: Statistics Bureau of China (1991, 1996), Beijing Statistical Yearbook (1991, 1996), 1991/96 Statistical Yearbooks of Shanghai

Table 1: Urban densities in Chinese cities, 1990 and 1995 (persons per ha).

		Urban densities (persons/ha)
Australia/New Zealand cities	Sydney, Perth, Melbourne, Brisbane, Wellington	15
American cities	Atlanta, Chicago, Denver, Houston, Los Angeles, New York, Phoenix, San Diego, San Francisco, Washington D.C.	15
Western European cities	Graz, Milan, Vienna, Bologna, Brussels, Rome, Copenhagen, Helsinki, Amsterdam, Oslo, Lyon, Nantes, Barcelona, Paris, Madrid, Marseilles, Stockholm, Berlin, Bern, Frankfurt, Geneva, Hamburg, Zurich, Dusseldorf, London, Munich, Manchester, Ruhr, Newcastle, Stuttgart, Glasgow, Athens	55
Chinese cities	Beijing, Shanghai, Tianjin, Guangzhou, Hangzhou, Ningbo	146
High income Asian cities	Osaka, Sapporo, Tokyo, Hong Kong, Singapore, Taipe	150
Low income Asian cities	Manila, Bangkok, Mumbai, Chennai, Kuala Lumpur, Jakarta, Seoul, Ho Chi Minh City	204

The metro regions outside China are from Kenworthy and Laube (2001)

Source: Kenworthy and Laube (2001)

Table 2: Comparison of urban densities in global cities, 1995 (persons per ha).

2.3 How do Chinese Cities Compare in Land-Use Characteristics?

By any international standards, Chinese cities, like their other Asian neighbours, have high urban densities and are characterised by quite intensively mixed land-uses in their built-up areas. Table 1 provides the urban densities in 1990 and 1995 for six Chinese cities ranging in size from 1 million population up to 7 million population, while table 2 provides an international comparison of urban densities in 1995. The tables show that urban densities in the Chinese sample in 1995 ranged from 119 to 196 per ha, with an average of 146 per ha. This represented an apparent average reduction for the six regions of 18 persons per ha (11%) from the 1990 average of 164 persons per ha. These data, however, need to be considered in light of the discussion under Urban Planning Law and Regulations later in the paper, which indicates that the real decline in density between 1990 and 1995 is smaller than that shown in table 1.

The average urban density of Chinese cities in 1995 was approximately ten times the American and Australian-New Zealand (ANZ) cities, over 2.5 times the western European cities, and a little lower on average than the urban densities of some wealthy and low income Asian cities. It is apparent that the current urban form and land-use pattern in Chinese cities is quite distinct from all western cities. Further discussion of the unique nature of urban form in Asian cities can be found in Kenworthy et al. (1995).

2.4 Provision for the Automobile

Another key factor in automobile dependence is how well the automobile is catered for in basic transport infrastructure.

- Roads: The length of road per capita in Chinese and other cities is summarised in table 3. It shows that the Chinese cities are extremely low in this indicator compared to western cities, with

City	Walking/Cycling (%)	Transit (%)	Private Motor Vehicle (%)	Total (%)
Chinese cities	65.0	19.0	16.0	100.0
American cities	6.1	3.4	88.5	100.0
ANZ cities	15.8	5.1	79.1	100.0
W. European cities	31.3	19.0	49.7	100.0
High income Asian cities	26.5	29.9	41.6	100.0
Low income Asian cities	32.4	31.8	35.9	100.0

Source: Kenworthy and Laube (2001)

Table 4: Comparison of modal split for all trips in global cities, 1995.

only one-fortieth to one-thirtieth the road provision in Australian and American cities, one-sixth that of European cities, and much lower even than the average of other Asian cities. Furthermore, these data are for the "City Area", as described in the previous section because of the lack of data for the actual built-up area. Road length per capita is even more constrained in the built-up area. As the comparison illustrates, present road infrastructure in Chinese cities does not favour automobile dependence. It suggests that congestion will rise rapidly as motorisation proceeds.

- Parking: The number of parking spaces in the centre of Chinese cities (CBD in western terminology) is a very difficult item to obtain because of lack of statistics. However, the data we have collected demonstrates enough to make a useful comparison.

According to a report of the Transport Engineering Institute of Beijing's Traffic Management Bureau, the number of parking spaces in the Beijing metropolitan area in 1995 is 38,671. It is even lower in other Chinese cities. Shanghai had only 10,468 places in its CBD in 1996 and Guangzhou 25,061 places in its metropolitan area in 1995 (Wang, 1997; Auto Weekly, 1999; TSSPSB, 1997). The three Chinese cities of Shanghai, Guangzhou and Beijing in 1995 had 17 parking spaces per 1,000 jobs compared with 555 in the CBD of US cities, 505 in ANZ cities, 261 in W. European cities, 105 in wealthy Asian cities and 127 in low income Asian cities (Kenworthy and Laube, 2001). Chinese cities are indeed not yet built for the automobile, and as the data imply, it would take a total reconstruction programme to adapt them to the automobile on the scale of US and Australian cities.

	Metres per capita
Australia/New Zealand cities	8.1
American cities	6.5
Western European cities	3.0
High income Asian cities	2.2
Developing Asian cities	0.6
Chinese cities	0.4
Beijing	0.3
Shanghai	0.3
Guangzhou	0.5

Source: Statistics Bureau of China (1996)

Note: The reference area and population for Chinese cities are "City Area" as described in the methodology section because of difficulty in data availability. Correct populations have been used in each case.

Table 3: Comparison of road length per capita in global cities, 1995 (metres per capita).

2.5 Automobile ownership and usage

The rate of motorisation in Chinese cities is increasing quite rapidly and this fact lies at the heart of this paper. Data from the Traffic Management Bureau in Beijing and Hangzhou shows that vehicle ownership per 1,000 people has risen in Beijing from 23 in 1983 to 93 in 1994. In Hangzhou over the same period it rose from 15 to 37. In terms of absolute numbers, cars in Beijing in 1990 numbered 89,373 and in 1994 there were 259,921, or a threefold increase. Zhou (1995) discusses in detail some of the causes of this rapid rise.

Although these figures show the rate of growth in automobile ownership in Chinese cities has been fairly high in recent times, ownership and usage are actually still very low in an international sense. Automobile ownership per 1,000 people in Beijing, Shanghai and Guangzhou averaged only 26 in 1995 (Kenworthy and Laube, 2001). This is compared to 587 in American cities, 575 in ANZ cities, 414 in W. European cities, 210 in high income Asian cities and 105 in low income Asian cities in 1995 (Kenworthy and Laube, 2001). Total private motor vehicle (car and motorcycle) kilometres per capita in Beijing, Shanghai, and Guangzhou averaged 434 in 1995. This is in contrast to 12,847 in American cities, 7,416 in Australian cities, 4,532 in W. European cities, 2,292 in high income Asian cities and 1,110 in low income Asian cities in 1995 (Kenworthy and Laube, 2001).

2.6 Transport patterns

- *Modal Split*

Table 4 provides modal split in Chinese, American, ANZ, European, and Asian cities. The major urban transport modes in Chinese cities are obviously still bicycles, walking, and transit. Non-motorised modes account for 65% of total trips while cars and motorcycles account for 16%, which is significantly lower even than in other Asian cities. The other important point about these data is the comparatively poor use of transit in Chinese cities. This is pursued later in the paper.

- *Walking and Cycling*

Walking and cycling are still the most popular modes in Chinese cities. Despite the fact that in some cities the authorities wish to restrict the bicycle, the number of bicycles is still steadily rising with population, with little evidence of any significant slowing down, at least not up until 1995 (table 5). It is interesting to note that the level of bicycle ownership in most Chinese cities in the early 1990s was in excess of typical total motor vehicle ownership rates in US cities. US cities averaged 755 total vehicles per 1,000 persons in 1990 (Kenworthy and Laube et al., 1999). The rate of bicycle growth in Chinese cities significantly outstripped population growth between 1990 and 1994.

However, Hook and Ernst (1999) report that in south China, the use of bicycles is falling rapidly. For example, they state that in rapidly motorising Gungzhou, bike use dropped from 34% of total trips to 24% in one decade. Pendakur (1992) and Smith (1995) discuss this issue in more detail. Modal choice in favour of the bicycle is strongly related to the trip distance and the physical condition of users. Bicycles are the most popular mode between 5 and 30

	Population		Number of bicycles			Increase in bicycles	
	1990	1994	1983	1990	1994	1983–90	1990–94
Beijing	7,000,000	7,260,000	4,290,000	6,272,568	7,885,188	46%	26%
Hangzhou	1,340,000	1,440,000	628,833	834,020	1,272,665	33%	53%

Source: Traffic Management Bureau in Beijing and Hangzhou

Table 5: Number of bicycles in Beijing and Hangzhou, 1983 to 1994.

minutes travel distance, which is usual for most trips in Chinese cities.

- *Public Transport*

Although public transport vehicle numbers per capita are still low, public transport passenger kilometres per capita are fairly high in Chinese megacities. Public transport vehicle numbers per million population in Beijing, Shanghai, and Guangzhou in 1995 average 711. This is compared to 616 in US cities, 1,066 in ANZ cities, 1,247 in western European cities, 1,195 in high income Asian cities and 2,547 in low income Asian cities. In addition, most of these cities have a significant higher capacity rail component as part of their vehicle numbers, whereas the Chinese cities have almost all buses, apart from in Beijing (Kenworthy and Laube, 2001).

Nevertheless, the public transport passenger kilometres per capita in Chinese cities averaged 1,897 in 1995, which was higher than western European cities (1,524). However, it is well below the high income Asian cities (3,636) and about the same as the other low income Asian cities (1,944). Of course, public transport use in Chinese cities far exceeds that in US and ANZ cities (488 and 918 respectively).

The average occupancy per public transport vehicle in Chinese cities is also very high (53 persons per vehicle on average). This is compared to 14, 17, 20, 36 and 38 in the US, ANZ, European, high income and low income Asian cities respectively. Average public transport system speed is only 14 km/h, while the other cities range between 18 km/h and 33 km/h.

This is consistent with the crowded situation in buses in most Chinese cities. The major result of poor transit provision is that transit usage is depressed. It suggests that Chinese cities are not well prepared in terms of public transport development for the onslaught of the private car or motorcycle. Trips will tend to shift from non-motorised modes to cars and motorcycles if transit systems are not better developed. This will be discussed later in this paper.

2.7 Traffic Safety

The cost of road trauma in any society is a major issue, both economically and in terms of human pain and suffering. Table 6 shows the number of transport deaths per 100,000 persons in the Chinese cities compared to cities in other regions.

In an international context, deaths in transport accidents are relatively low in Chinese cities. The data seem to suggest that traffic deaths tend to follow both the degree of automobile dependence and the level of development of the traffic regulatory system. In American cities with their highly developed road systems and strictly regulated traffic, traffic deaths are very high, due it seems to the world's highest level of exposure of the population to auto traffic (Kenworthy and Laube, 1996).

The situation in Chinese cities can be expected to worsen and perhaps begin to mirror the picture in the other rapidly motorising Asian cities in this sample (15.2 deaths per 100,000 people) as more and more traffic begins to mix with the high numbers of pedestrians and cyclists. This is especially true if little or nothing is done to slow down this rate of motorisation or to plan for effective harmonisation of motorised and non-motorised transport (Hook and Ernst, 1999).

2.8 Summary

The comparisons here have answered the first question put forward in the beginning of this paper about how Chinese cities compare with their international counterparts. It has shown that urban form and infrastructure provision are not in favour of heavy automobile use in Chinese cities, and automobile ownership and usage were still very low in 1995, even compared to other Asian cities. The next step is to look at how Chinese cities might develop in land-use and transport terms as they continue to modernise and attempt to accommodate the automobile.

City	Number of deaths in transport per 100,000 persons
Chinese cities	8.6
American cities	12.7
Australia/New Zealand cities	8.6
Western European cities	7.1
High income Asian cities	8.0
Low income Asian cities	15.2

Source: Kenworthy and Laube (2001)

Table 6: Comparison of transport deaths in global cities, 1995.

3. Nature of the Chinese City: Accommodating Motorisation

As is well established, the automobile city is not efficient or effective in an environmental, economic, or social sense (Newman and Kenworthy, 1999). However, for China, the issues are particularly acute because of the resource availability problem, which must inevitably be confronted as automobile dependence rises.

3.1 Issue 1: Acquiring the Immense Amount of Land and Capital Investment Required in Infrastructure to Accommodate a Large Automobile Fleet

China possesses a vast territory, however, it is not rich in arable and inhabitable land, especially compared with the huge population. Land is in fact a major limitation for China. Nevertheless, with the economy booming and rapid urbanisation, even at high urban densities and with very low automobile dependence, the total amount of agricultural land has decreased significantly in the last two decades. It is reported that over 200,000 ha, including 100,000 ha of arable land, were requisitioned for construction purposes every year (People's Daily, 1996). Agricultural land reduction is already a serious problem that has occurred even during the non-motorised transport era prior to the current motorisation leap.

If Chinese cities are to accommodate large numbers of automobiles, urban

density would inevitably have to decrease greatly, with a vast demand for land for transport infrastructure including roads, parking, lower density houses, auto-orientated retail, commercial and industrial developments. With motorisation, Chinese cities would begin to manifest many of the characteristics of western style suburbanisation. How could Chinese cities accommodate this trend? And is it worth doing in an economic sense?

The People's Daily reported on February 6, 1996 that the Beijing Traffic Management Bureau has announced the "Public Notice for Decreasing Traffic Flow". This notice regulates that jeeps, cars and other small passenger vehicles are permitted to run only on odd or even dates during weekdays according to the last digit of the number plates (Tian and Pan, 1996). The reason behind this is to control traffic congestion. Beijing spent 309 million US dollars on roads (excluding resumption fees for land and houses) between 1990 and 1994 (Kenworthy and Laube, 2001). Much of the road surface is now dedicated to motor vehicles, while pedestrian and cycling facilities are degraded. Hook and Ernst (1999) reported that the situation is getting worse with segregated bicycle lanes in Beijing torn out for automobiles, and other lanes blocked by parked cars. Bicycle parking space is being relocated and convenient space is being converted to car and motorcycle parking. This trend is especially evident in new commercial and retail developments. Meanwhile, traffic congestion has increased over 1,000 times a month in Beijing in 1995. The average speed of motor vehicles on the second and third ring roads, which are the widest ones in the metropolitan area, reduced from 45 km/h in 1994 to 33 km/h in 1995. And the overall average road network speed reduced to 12 km/h (Tian and Pan, 1996).

As far as land is concerned, parking is another problem in Chinese cities. It is reported that only 10 to 20% of private cars have their own garages in Chinese cities. More cars just park in public open space in residential areas (Zhu, 1996).

Some questions which must therefore logically be asked are: How many roads would have to be widened and constructed in Beijing and other cities to accommodate the massive automobile fleet if it follows the American model? How much land would be consumed by transport infrastructure and its by-product – urban sprawl? Is it economically efficient to develop automobile cities in China? Detailed answers to these question are beyond the scope of the paper. However, the data and discussion that have been presented here suggest that the answers to these questions may be painful for those holding a vision of a future China with similar levels of automobile ownership and use as those found in the west.

3.2 Issue 2: The Environmental Impacts of Automobile Dependence

Some research suggests that urban air pollution has exceeded even the national standard, sometimes by a few times, in most major cities in China. With better control of coal burning in industry through investment in environmental technologies and by moving factories away from city centres, the proportion of vehicle exhaust emissions has rapidly increased. Hook and Ernst (1999) report that transport is the fastest growing source of urban air pollution and is now responsible for 80% of CO, a majority of particulates and 40% of NO_X in major cities. A study in Beijing shows that CO concentration exceeds the national standard by over 100% and NO_X is exceeded by over 50% on some main roads. A linear pollution belt can be observed along these roads, especially in the warm seasons. In Beijing 79% of HC, 80% of CO and 55% of NO_X are from vehicle exhaust emissions (Xiang, 1995).

Of course, air pollution is only one of the environmental impacts associated with burgeoning car ownership and use. Others include growing noise, major local traffic impacts in terms of severance of neighbourhoods, vibration effects on buildings and the sheer space consumption and intrusion of motor vehicles into the public realm, which adversely affects interaction in public space and traditional community in Chinese cities. Such issues constitute major tensions within a society embarking upon a new era of motorisation.

3.3 Issue 3: Finding the Oil Needed to Feed Huge Numbers of Vehicles, and the Cost of This in the Next Century

If the number of private cars increases to 13.2 million by 2010 as some have predicted, oil consumption would greatly be increased. China would have to import a significant amount of oil from the international market. According to a study by Campbell and Laherrere (1995), the global peak in cheap oil production will occur in the first ten years of this century and production capacity will then begin declining. Thereafter world oil production will halve every 25 years. Some questions, which China will therefore need to consider, are: Where would China get the vast quantity of oil required? Is it wise for China to compete with other countries for oil on the international market at a time when prices are likely to rise significantly? How much would it cost? Is it worth doing?

Considering that the per capita use of private passenger transport energy in Guangzhou, Shanghai and Beijing, averaged only 2,498 MJ (megajoules) per person in 1995 compared to 60,034 MJ in US cities, auto dependence is a major energy issue for China to confront. Again, answers to these questions are likely to be painful.

3.4 Issue 4: Urban Liveability

It might be expected that the process of motorisation would begin to have a relatively large impact on the traditional, dense and compact Chinese city with its vibrant urban life and long cultural and architectural heritage. As in Europe in the 1960s, this process of declining public livability of cities may have some moderating effect on the rush towards motorisation (e.g. see Kenworthy, 1990).

4. Policy Implications

4.1 Land-Use Constraint by the Land Management Law

The Land Management Law of the People's Republic of China, which was enacted on December 29, 1988, is one of the four national fundamental laws defined by the Constitution in China, which take precedence over other laws and regulations.

In chapter 1, clause 1, it states: "According to the Constitution, this law is formulated in order to enhance land management, safeguard land's socialist public ownership, protect and exploit land resources, reasonably use the land, strictly protect the arable land, and promote social and economic sustainability."

In chapter 1, clause 3, it states: "Very esteemed and reasonable use of the land, and strict protection of the arable land is one of the fundamental strategies of the country. Every level of local government should adopt measurements, integrate planning, tighten management, protect and exploit land resources, and restrain illegal occupying behaviour on land."

The Land Management Law of the People's Republic of China is designed to prevent massive urban sprawl as has occurred in America and Australia, and also restrains excessive use of land for transport infrastructure. This is one of the major differences between Chinese cities and some other Asian cities.

4.2 Urban Planning Law and Regulations

The Urban Planning Law of the People's Republic of China, which was enacted on December 26, 1989, is another important law that enables urban planning to be consistent with the national fundamental laws, and also ensures the implementation of urban planning principles. There are a few special regulations under the urban planning law, which are important to understand.

As has been explained, Chinese cities are traditionally high density and mixed in their land-use. There is no evidence to show that Chinese cities (except in remote areas) would be allowed to reduce their density to a medium or significantly low level to accommodate cars. Indicators in tables 7, 8, and 9 explain how urban planning is controlled in China in practical terms.

Table 7 sets out the standard for per capita "construction land" for different grades of urban development. "Construction land" includes residential land, commercial and public facilities land, industrial and manufacturing land, warehouse land, transport and public squares land, municipal utilities land, green land, and special purpose land. These are defined in the Urban Land-Use Classification and Code, and the Urban Land-Use Classification and Planning Land-Use Standard.

According to the regulation, the planned per capita land-use should be in context with both the present per capita land-use level and the defined grade of the city with a permitted range in which adjustments can occur. The grade definition is specified by the Urban Land-Use Classification and Planning Land-Use Standard (GBJ 137–90), which is published in the State Standards of the People's Republic of China. It defines that new urban development should normally be regarded as Grade 3, but in land constrained areas, it should refer to Grade 2. For the capital city and some special economic zones, such as Shenzhen and Haikao, Grade 4 is recommended. Grade 1 is usually used for old and dense central city areas where land is extremely limited.

Tables 8 and 9 provide more details in four major urban land-use categories: residential land, industrial land, roads and public squares land, and green land. Table 8 gives the permitted ranges of per capita land-use of the above four categories. Table 9 defines the permitted ranges of land-use in each category in percentage terms.

Following the above regulatory requirements, the density of urban development in China would generally not be allowed to be lower than 100 persons/ha. Newman and Kenworthy (1999) explain that 100 person per ha or more is typically associated with "walking cities", certainly not heavily auto-dependent cities. Although, the data in table 1 show an 11% decline in urban densities from 1990 to 1995, based on official data, the following points should be noted.

First, the density in the central area of some large cities was too high. Some areas in Shanghai were over 500 persons per ha. Some cities such as Ningbo nearly rebuilt the whole central area to provide better facilities such as a large city square and central city gardens, making the city more liveable. These changes would have caused some downward tendency in density in the interests of enhanced liveability as incomes have risen, although they would also have reduced mixed land-uses and permitted greater space to be allocated to the car, to the likely detriment of walking and cycling.

In addition to this, most Chinese cities experienced significant development in the 1990–95 period, as a result of economic liberalisation by Deng Xiaoping in 1992. This resulted in rapid increases in the built-up area for many large cities. Counter to this, however, the "true" population of these cities is not recorded, because many new residents flooding in from rural areas as a result of policy liberalisation, were outside of the registration system. Most cities had 10 to 20% "floating population", especially the coastal and large cities, and the proportion in 1995 was larger than in 1990. It was estimated that Shanghai may have had 2 million people excluded from the statistical system in 1995, more so than in 1990. The true density of Shanghai (and other cities) in 1995 is therefore closer to the density in 1990 than it appears to be (table 1). Guangzhou and Shenzhen may have the highest percentage of "floating population" because of economic development and a more open population policy.

In terms of land-use for roads, the Ministry of Construction rules that main roads should be between 30 and 60 metres in width, which consists of motor vehicle lanes, non-motor vehicle lanes, and footpaths. The secondary trunk routes should be between 24 and 40 metres, including 2 to 4 motor vehicle lanes. The local roads should be between 15 and 20 metres including 2 to

Present per capita land use level (m^2/person)	Planning per capita land use		Permitted adjustment range (m^2/person)
	Grade	Per capita land use (m^2/person)	
≤ 60.0	1	60.1– 75.0	+0.1–25.0
60.1–75.0	1	60.1– 75.0	>0
	2	75.1– 90.0	+0.1–20.0
75.1–90.0	2	75.1– 90.0	no limitation
	3	90.1–105.0	+0.1–15.0
	2	75.1– 90.0	–15.0–0
90.1–105.0	3	90.1–105.0	no limitation
	4	105.1–120.0	+0.1–15.0
105.1–120.0	3	90.1–105.0	–20.0–0
	4	105.1–120.0	no limitation
>120.0	3	90.1–105.0	<0
	4	105.1–120.0	<0

Source: State Standard of People's Republic of China. Urban Land-Use Classification and Planning Land-Use Standard, Ministry of Construction, March 1, 1991

Table 7: Standard of per capita land-use in China.

3 motor vehicle lanes (Ministry of Construction, 1994). The regulations also provide some options for road surface allocation for different users. It seems that footpath and non-motor vehicle lanes are usually recommended to account for half the width of main roads. Footpaths are also emphasised in lower level roads.

4.3 Environmental Law and the National Ambient Air Quality Standard

Although it is difficult to meet reasonable standards of air quality in some Chinese cities, the Chinese government is currently making efforts to ensure air quality improvement and that existing air quality regulations are more respected. In practice, air pollution in many Chinese cities is quite serious and increases in motorisation make it more difficult to control. However, recently there have been some important advances in control of emissions from vehicles in Beijing, requiring more stringent emissions controls on cars manufactured in China (Hook and Ernst, 1999).

	m^2/person
Residential Land	18.0–28.0
Industrial Land	10.0–25.0
Roads and Squares	7.0–15.0
Green Land	≥9.0

Source: State Standard of People's Republic of China. Urban Land-Use Classification and Planning Land-Use Standard, Ministry of Construction, March 1, 1991

Table 8: Permitted ranges of per capita urban land-use (m^2/person).

	%
Residential Land	20–32
Industrial Land	15–25
Roads and Squares	8–15
Green Land	8–15

Source: State Standard of People's Republic of China. Urban Land-Use Classification and Planning Land-Use Standard, Ministry of Construction, March 1, 1991

Table 9: Permitted ranges in the percentage of urban land allocated for different uses (%).

4.4 Public Transport Policy

Government reports and documents show that the Chinese government has been trying to promote public transport development, though financial difficulties have slowed down the process. A statement issued by the State Council in 1985 urges that: "For passenger transport in big cities, the principle of developing track-transport should be adopted. It is difficult to solve the transport problem by relying on current buses, trolley buses and limited roads. Rather we must 'go up towards the sky and down underground' and realise multiple-level, multiple-structure 'stereoscopic' transport systems."

The Ministry of Construction also issued a Current Industry Policy for Carrying Out Of Urban Transport (CIPCOUT) in 1990, following the above document. The CIPCOUT further emphasises the importance of urban public transport planning, and requires that transit be integrated into urban planning. The Ministry of Construction then formulated Design Regulations for Stops, Stations and Factories of Public Transport in order to improve the effectiveness of public transport planning. Subsidies and some priorities, including supply of fuel and other raw materials at lower prices, are given in order to maintain effective transit operations. Ownership reforms are also gradually being introduced.

More importantly, new urban rail systems are about to be launched in the next decades. Although only Beijing, Tianjin, and Shanghai had built subways by 1995, local governments are enthusiastic about rail systems. As of 2000 over twenty cities have lodged applications for rail projects, though the planning department of the central government is still cautious in ratification because of the huge amount of capital investment required, as well as the general requirement of national macroeconomic control. It is said that the central government's attitude towards rail transport can be described as "both fondness and heavy-heartedness" (City Planning Review, 1995, No. 1, p.25).

4.5 Summary

The major evidence concerning the possibility of future growth in automobile dependence distinguishes Chinese cities from Bangkok and some other developing Asian cities, in that China has clear and strict national laws and regulations to secure the control of urban development. China's centrally planned economy, though relaxing to some extent, has its advantages in some circumstances, especially in its potential capacity to integrate planning of land-use and transport in cities.

5 Towards Sustainability of Transport in Chinese Cities

5.1 Private Cars

Although the major urban policies in China intend to maintain high density and mixed land-use, and to encourage walking, cycling, and public transport, as in many other places, a variety of policy conflicts always exist. Integrated transport planning and urban management are evolving in China, as they are in the west.

It is not hard to understand a government department's position, which is responsible, for example, for the national machinery industry, wanting to promote and protect a national automobile industry. A casual glance to the east reveals some of the economic successes which can flow from a healthy automobile industry.

However, the national Automobile Industry Policy, which was propounded by the former Ministry of Machinery Industry, encountered resistance from some local governments, urban planners, researchers, and other departments once it was released via the media. It was formally reviewed in a symposium organised by the Urban Sciences Association of China on March 17, 1995.

Liu Jun, the director of the Department of Motor Vehicle Industry in the Ministry of Machinery Industry, addressed the initial thinking of the document. She said that automobile industry development is an inevitable result of economic growth, which has been proven from the experiences of a number of other countries in the world. She also asserted that the national economy is under pressure to choose appropriate "pillar" industries. She quoted the case of Japan to explain that a "large population and lack of land" is not a limitation for "Private Car Entering Family". Meanwhile, it is viewed as time to foster a national industry to compete with foreign companies entering the potentially vast Chinese market. Liu's opinion expresses the perceived economic and political realities behind the document.

Following Liu's speech, some researchers questioned how Chinese cities could accommodate so many automobiles when present urban transport issues are already serious. Zhao Jianing, a deputy director of the Department of Urban Construction in the Ministry of Construction, addressed the limitations of automobile development in Chinese cities. His speech represented the views of most planners, as well as the Ministry of Construction.

It is obvious that opinions over the automobile are still not consistent, even among central government departments in China. Nevertheless, the automobile industry policy has become rather less prominent since it was released, with pressure from national and international organisations. The Far Eastern Economic Review reported that China had: "ceased calling its car industry a 'pillar' of the economy. The move came during an annual four-day economic plenum attended by the top leadership [...]. Sources say plenum participants allowed the car industry's status to crumble after it became obvious that the goal of an affordable car for all families would mean national gridlock" (TFEER, 1996).

It can be said that the car in itself is not a devil, it is a convenient means of private transport when used appropriately. The problem for China, and indeed all other nations, is how to deal with the issues raised by mass car ownership, and increasing dependence on the automobile to the detriment of other modes. A proper balance of modes must be found in all cities to ensure sustainability and to protect liveability. It is particularly important for the Chinese government to integrate the various economic and planning policies towards the automobile at an early stage. This has been the basis of Singapore's success at controlling car ownership and use to comparatively low levels while still advancing economically.

A potential major problem that China will face in this regard is the recent World Trade Organization agreement (November 1999). Under this agreement, China has been effectively forced by western nations to accept overseas non-bank lending institutions into the country with the express purpose of providing access to credit for motor vehicle purchases (The Chinese Herald, November 22, 1999, p. 5). In this sense it is somewhat ironical for western nations to express grave concerns about motorisation in China, and at the same time be facilitating changes that will make this more likely to happen.

5.2 Walking and Cycling

High density and mixed land-use, especially with a high degree of "work unit" provided houses, arising from the previous economic era, make non-motorised modes particularly convenient in Chinese cities. Home and work in these environments are often tightly linked.

As mentioned previously, modal choice in favour of the bicycle in Chinese cities is strongly related to trip distance and the physical condition of users. Bicycles are an ideal mode for travel between 5 and 30 minutes. Because of high density and compact urban forms, the sizes of most Chinese cities are within these travel time ranges.

Other reasons for the popularity of bicycles in Chinese cities are the poor provision of public transport and the low cost of bicycle operation. As discussed previously, public transport is overcrowded especially in rush hours. It is reported that 52% of bus ridership in Chinese cities is in peak hours (6:30 to 8:30 and 16:30 to 18:30). Passenger boardings on buses sometimes reach 13 people per square metre in peak hours (Wang, 1995). This inevitably makes cycling the favourite mode for commuting. The government subsidised bicycle commuters in the 1970s and 1980s when oil supply was constrained in the country. Even at present, bicycle costs are still lower than any other mechanical modes. The price of a typical new bicycle is around US$50, half of an average month's salary, with up to ten years' life. It is also easy to maintain and to park. If door-to-door time is considered, the bicycle is usually faster than buses when making up to a 5 kilometre trip. Cycling, as a convenient and healthy mode of transport, is still likely to be extensively used in the future. On the other hand, the bicycle is inconvenient on rainy or windy days, and is apt to be stolen, so that there is a need for other options at certain times.

Integrating cycling and public transport is a feasible and effective strategy. Both these modes have their unique strengths and weaknesses. Together they can or could offer competitive performance over the private car for most trips. Better facilities such as bicycle-transit exchange hubs around transport stations in association with commercial services could attract more people to

transit, convert long-distance bicycle commuters, improve transport efficiency, and relieve road traffic pressure.

On the negative side recent main road development in major Chinese cities is focussed on building overpasses for pedestrians and cyclists. This results in more difficulties, especially for children and elderly people, and also creates visual intrusion. There seems to be little doubt that Chinese cities, which have been shaped by non-motorised transport, will need to enact policies that protect the important role of these modes if they are to avoid major future problems.

5.3 Public Transport

High densities create sufficient concentrations of activities for an effective, frequent public transport service (Newman and Kenworthy, 1996). Despite this positive land-use framework in Chinese cities, providing better public transport is actually a key issue in Chinese urban transport. An integrated transit system could decrease cases of very heavy bicycle traffic, reduce private transport, and therefore increase road efficiency. In order to realise the goal of better transit systems, some issues need to be reviewed.

Firstly, the bus fleet could be relatively easily increased in the early stages of public transport development when high capital investment for rail systems is still difficult. Limited bus capacity is one of the reasons for poor service provision. Secondly, bus priority should be given. This priority includes specified bus lanes and bus activated traffic lights. It is common in Chinese cities to see buses caught in congestion and many people waiting at stops. With priority, buses can run faster and more efficiently, which makes them more reliable and therefore more attractive.

Thirdly, it is important to integrate public transport with other transport modes, as described above. This will allow a greater variety of connections to be made and greater flexibility for the non-car user.

The fourth issue is to reduce the number of staff and to make transit systems more cost efficient. Table 10 shows the average number of staff for every bus is 12, compared to 2 to 4 in developed cities (APTA, 1991). It is suggested that savings from the large amount of salary spending could help to finance the vehicle fleet update and expansion in Chinese cities.

	Number of			Income (million CHN$)		Costs (CHN$/1,000 km)	
	Buses/ Trolley Buses	Staff	Staff per Bus (average)	Ticket Income	Government Subsidy	Annual Cost	Fuel Cost (estimated)
Beijing	5,378	58,410	11	362.60	212.10	1661	550
Shanghai	6,562	86,325	13	611.30	187.00	1750	580
Hangzhou	779	7,648	10	47.85	13.06	1565	570
Tianjin	2,063	23,193	11	85.00	61.00	1326	550
Shengyang	1,261	9,485	8	38.50	17.90	1192	600
Wuhan	1,523	20,092	13	112.90	21.60	1205	600
Ningbo	207	1,983	10	14.84	2.48	1083	490
Average	2,539	29,591	12	–	–	1397	563

Source: Public Transport Association of China (1992)

Table 10: Staff numbers and operational costs in bus companies in Chinese cities (1991).

The fifth and final issue is to increase ticket prices. Chinese bus tickets are perhaps the cheapest in the world. The average rate is less than US 0.5 cents per passenger km, compared to US 1.7 cents in Manila and US 6 to 9 cents in Australia, America and Europe (Kenworthy et al., 1997). The main reason behind the low price is not the low quality of service provision but political unwillingness to do something that is likely to be unpopular.

Xiamen's success demonstrates that transit can be operated very well in Chinese cities. In this medium size city, the bus fleet was doubled, bus lines increased from 8 to 28, passenger boardings increased from 70 million to 170 million, revenue increased from CHN$ 1.25 million to $6.08 million, and all this happened in three years without any subsidies from the government (Zi and Gong, 1996).

In the context of the built form of Chinese cities, it seems imperative that there be continuing improvements to public transport, especially the eventual development of good urban rail systems.

6. Conclusion

The growing trend towards motorisation in Chinese cities presents a number of important opportunities and challenges, both for the cities themselves and potentially for the global environment. For Chinese cities, automobiles mean a whole new way of life for the residents of the world's most populous country, offering levels of personal mobility previously unthinkable. For global car manufacturers, China offers one of the biggest markets in the world. The benefits will, however, exact a toll on the urban environment and the quality of public spaces and human interaction in Chinese cities, as the automobile has in countless other cities. Accommodating the automobile will also have big impacts on China's land supply for agriculture and on its economy through a whole range of new costs. For the global environment, China's potential demand for oil and its rising greenhouse contribution are major uncertainties.

Chinese cities need, however, to be understood in an international context before the sceptre of unbridled automobile dependence, as exhibited in the US, is accepted uncritically. When a detailed analysis of Chinese cities is carried out the data reveal urban environments of very high density and mixed-use urban forms. It also reveals levels of car ownership and use that were in 1995 very low by world standards, though with evidence that they are increasing rapidly, with very little physical or economic constraints being imposed on this process. Non-motorised transport was still very strong in 1995, though space for pedestrian and bicycle movement is under enormous pressure, especially from political leaders in cities who see the bicycle as a symbol of backwardness. Public transport usage in 1995, by international standards, was still high, although this predominantly consists of captive riders, not

choice riders. Such captive riders will all too readily switch to motor cycles and cars as their growing incomes allow them to escape the crowded conditions and slow and unreliable services of public transport systems based mainly on buses. Chinese public transport systems are significantly constrained in their fleet capacity and service levels and do not have a high proportion of services provided on reserved rights-of-way (i.e. dedicated busways and rail systems).

Analysis of the urban planning policy context in China does reveal a strong planning tradition, under a centrally planned economy. However, economic liberalisation is placing enormous pressure on the land-use controls previously exerted by the planning system and these controls are not very well-coordinated with transport. Much new development will require significant use of motor cycles, private cars and taxis, rather than public transport systems.

It is still an open question if the Chinese planning tradition will be strong enough to prevent or reverse severe negative impacts of motorisation, which are already beginning to be quite evident throughout many Chinese urban centres. Critical to the future will be the institutional capacity and willingness of China's planners and decision-makers to control the use of land in ways they have done in the past and to better link urban development with improved public transport systems. In this respect there will also be a need to balance investment in new high capacity road infrastructure with investment in improved bus systems and new rail systems, or even to prioritise public transport systems above road investment. According to 1995 data in Kenworthy and Laube (2001), Chinese cities are second only to North American and Australian cities in the ratio of road investment to public transport investment. An average of twice as much was spent on roads than on public transport over a 5-year period from 1991 to 1995, so the pendulum has some way to swing back. Furthermore, it will also be essential to have strong space sharing policies that allow non-motorised modes to dwell alongside cars in a way that they can continue to flourish safely and contribute to access, mobility, energy savings, air pollution and noise reductions, and healthy urban community. This will mean resisting the removal of generous bicycle lanes and footpaths for parking and road widening.

Pressures to enact policies in favour of strict, coordinated land-use controls for new development, investment and planning priorities towards public transport and non-motorised transport properly integrated with urban development, and preservation of traditional high density, mixed land-use areas, are likely to encounter obstacles. They will have to be balanced or harmonised with China's apparent desire to have a strong automobile industry, WTO efforts to ensure that credit is freely available in China to purchase cars and the multiple influences of overseas car manufacturers eager to claim a stake in the Chinese automobile market.

Overall, it remains a significant challenge for Chinese planners and decision-makers to ensure that the many positive land-use and transport qualities of Chinese cities are protected against the excesses of automobile dependence, while still reaping the full benefits of rapid economic growth. The international data comparisons of urban transport also show, however, that Chinese cities are still amongst the least auto-dependent in the world. It is western cities, especially those in the United States, who have the biggest potential to reduce their already extraordinary levels of automobile dependence and global resource consumption. Unless this point is recognised, studies and concerns about motorisation in China, may remain somewhat distorted.

Acknowledgement/Note

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[1] Though the Chinese system is somewhat unique, the problems faced here with regard to specifying data on an urbanised area basis are similar to those in other cities. For example, although the US Census has a reporting category called Urbanized Areas and publishes a lot of data on this, much essential transport data do not relate readily to this, and one has to accept data for the Counties within which the urbanised areas fall as being reasonably representative. In Australia, the cities are specified as "metropolitan statistical divisions" and include a lot of non-urban land. Urbanised land area is not readily available and there is virtually no data at all published on the basis of actual urbanised area. Urbanised land area must be gleaned from the planning authority's GIS operators in each city. In Europe it is easier to specify the urbanised land area within different metropolitan regions because there is nearly always a good land-use inventory available. However, most data refer to the whole metropolitan region and it is virtually impossible, for example, to get vehicle registrations or road length or any other transport item just for the urbanised component of the region.

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Shaping Sustainable Energy Use in Chinese Cities

The Relevance of Community Energy Management

A significant share of future urban energy consumption is predetermined when land-use and urban form are designated. Community Energy Management (CEM) is a sustainable energy strategy which looks at how shaping the built environment and designing urban services in consideration of energy production, distribution and use could affect both the long term demand for energy and the type of energy supplied. This energy policy perspective is particularly relevant to China as that country is experiencing rapid urbanisation and significant urban air quality issues.

A spreadsheet model is used to evaluate aggregate energy-related emissions in the year 2015 from two alternative scenarios of urban growth throughout China. The model focuses on how energy demand, residential energy technology penetration and transportation mode choices are affected by factors of density and mix of use in neighbourhood development. Results from this exercise suggest that China can achieve urban residential and transportation emission reductions of approximately 14% for CO_2, 10% for SO_2, 40% for NO_X and 14% for particulate emissions in 2015 by adopting certain aspects of CEM. Issues around the implementation of CEM are also addressed in this study by examining key institutional and policy issues involved in land-use planning, site and building design, alternative energy supply and transportation management. Recommendations and implementation strategies are suggested.

1 Introduction

A significant share of future urban energy consumption is predetermined when land-use and urban form are designated. Patterns of urban form and infrastructure can have a significant effect on energy efficiency and the type of energy supplied: for instance, cities that more closely integrate residential and commercial activities in higher densities and support extensive community energy supply systems and public transit infrastructure can use considerably less energy for transportation, heating, cooking and other uses. Concerted efforts to promote urban growth in this direction are known as *Community Energy Management (CEM)*, which has recently gained some popularity in North America as urban areas come to terms with the environmental impacts of fifty years of disconnected and functionally segregated urban sprawl.

This policy perspective may be particularly relevant to China. Chinese cities make up 16 of the world's top 20 polluted cities, and almost half of Chinese cities monitored are unsafe according to the Chinese government's Air Quality Index (Stockholm Environment Institute, 2002). Cities are also growing at an astounding rate: between 1980 and 1999, the urban population more than doubled (World Bank, 2002). More than one half of all the urban structure in China, measured in terms of square metres, is estimated to have been added during the 1980's alone (World Bank, 1993). Influencing the long-term sustainability of on-going urban development could have profound implications on future urban energy use.

In this study we explore the benefits and viability of a CEM approach in Chinese urban areas, and in particular three questions. First, what strategies in land-use planning, transportation management, site and building design and energy supply would favourably influence the long-term energy sustainability of Chinese urban areas? Second, how would aggregate energy-related air emissions differ in alternative scenarios of future Chinese urban development? Third, how could CEM be implemented given present institutional and economic structures?

2 CEM Strategies for China

CEM studies have been primarily undertaken in an industrialised country context, where the nature of energy use and urban spatial form are considerably different. Per capita energy consumption is considerably lower, but is on the rise. Residential and commercial energy uses are dominated by dispersed coal burning, which is gradually declining in favour of coal gas and in some cases natural gas. Although this substitution helps reduce cooking and heating emissions, urban areas are faced with growing exhaust from increased numbers of cars, trucks and buses. Residences are becoming less spatially linked with the workplace, and outlying urban areas are often characterised by rapid-paced and piecemeal development. Cities are also starting to develop specialised neighbourhoods, such as downtown retail and business centres, residential districts and targeted development zones, resembling increasingly what is seen in the West (Gaubatz, 1995). [1]

CEM strategies that may be appropriate for reducing the long-term environmental impacts of energy use include those directed at land-use, energy use, and infrastructure provision. Efforts should be made to encourage greater mixed land-use, density and transit-oriented design in suburban developments, while maintaining mixed land-use in central areas. Activity centres and local neighbourhood services need to be included with outward extensions of the city. It is also critical to have sufficient densities and co-ordinated land-use that make the provision of district energy, gas infrastructure and rapid transit most economical. While China has encouraged the development of district energy systems in the past, their further provision is critical, particularly larger-scale, co-generated systems. District energy could be made more economical too by supplying hot water to public bath houses and by providing both district cooling and heating. [2] At the same time, a greater diversity of energy sources should be encouraged, such as gas (coal and other), liquefied petroleum gas, solar, wind and waste heat utilisation from industrial facilities. In addition to guiding energy infrastructure investments towards sustainable ends, transportation infrastructure

should be planned to maintain bicycle transportation and investments need to be made to improve the quality of public transportation, which has shown signs of decline. [3]

3 Measuring the Environmental Benefits of CEM

A spreadsheet model is used to broadly estimate the aggregate energy-related environmental effects of alternative scenarios of future Chinese urban development and residential energy planning. Two alternative scenarios of urban development in the year 2015 are evaluated. The first scenario, *Development of Current Trends (DCT)* outlines a future which reflects the trends which have occurred since China began its pattern of rapid economic growth, and the examples of newly industrialised countries. The second scenario, *Community Energy Management (CEM)* incorporates a number of CEM strategies into future urban development. The CEM strategies are discussed in more detail in table 1.

Environmental effects addressed in this study are limited to present and future atmospheric air emissions – CO_2, NO_X, SO_2 and particulate emissions, which emanate from residential and urban transportation energy sources. The exercise also limits energy end uses to those uses which are influenced by CEM strategies – more specifically, those uses affected by factors of density, mix of use in neighbourhood development, and policies which influence the level of development control, enforcement of building codes and new technology penetration.

Area	Strategies
Land-Use Planning	Land-use planning control resulting in more coordinated development.
	A tendency towards mixed land-use and the maintenance of dispersed business centres.
	A tendency towards maintaining a relatively high density, but not to the detriment of local environmental quality.
Transportation Management	A greater emphasis on public transportation development.
	The facilitation of bicycle and pedestrian transportation.
	The implementation of transportation management strategies to influence automobile use.
	The development of employer sponsored commuting services and other high occupancy vehicle travel.
Site and Building Design	Building to maximise the shape coefficient.
	Ensuring that buildings are built so that they can be easily and economically retrofitted for district heating and/or cooling.
Energy Supply and Delivery Systems	The replacement of decentralised and uncontrolled coal combustion in individual apartment blocks and dwellings.
	Encouraging the interaction of industrial energy provision with residential uses.
	A faster introduction of new fuels and technologies (such as district cooling, waste heat) and increased gas penetration for cooking and heating.

Table 1: CEM scenario.

Development Class	Definition	Example
L1	Low rise, mixed use	1 to 3 stories – mainly old pre-1950s buildings
L2	Low rise, non-mixed use	1 to 3 stories – new villas, exclusive suburbs
M1	Medium rise, mixed use	4 to 10 stories – mainly 1950s–1980s development, and some new development
M2	Medium rise, non-mixed use	4 to 10 stories – mainly new, >1980s development in rapidly changing cities, as well as older development in areas of low "non-productive" investment such as satellite cities
H1	High rise, mixed use	>11 stories — mainly new development which maintains mixed neighbourhood
H2	High rise, non-mixed use	>11 stories — new development in rapidly changing urban areas

Table 2: Description of development classes.

3.1 Methodology

The methodology used to evaluate the future scenarios described above consists of dividing the present and future urban population of China into *Development Classes* – groupings which characterize different residential building patterns (i.e. mix of use, type of building) – for both the CEM and DCT scenario. Total emissions for each scenario are determined by multiplying the population in each respective development class by the per capita emissions for each development class *(Development Class Emission Rates)*.

Each step is developed in greater detail below:

- *Development Classes*

In each future scenario, the projected urban population is divided between different types of development classes. These are described in table 2. The type of development class guides the type of end use technologies that are adopted and the level of energy consumption, which in turn impacts the level of air emissions. Specific development classes have been advanced which characterise the nature of building types and the mix of land-use in Chinese communities, based on urban spatial and urban form patterns discussed in the literature (Gaubatz, 1995; Feng Liu, 1993; World Bank, 1993).

- *Development Class Emission Rates*

Total per capita emissions for each development class are determined as follows. Energy end use categories and technologies (or modes) that meet these energy needs are described (table 3). Emission rates for CO_2, NO_X, SO_2 and particulates (t/GJ) are determined for each technology. For the present and for the competing future scenarios (table 1), technology market shares are described

End-use	Technologies/Modes
Space Heating	coal stoves, central heating (coal), district heating (coal), district heating co-generation (coal), electric heaters and gas (coal gas & natural gas)
Space Cooling	individual air conditioning, central air conditioning, and district cooling (co-generation)
Cooking	coal, piped gas, liquefied petroleum gas (LPG)
Transportation	transit, high occupancy vehicles (paratransit), pedestrian, cycling, motorcycle, automobile

Note: Although electric fans are currently the dominant form of cooling, they are not included because they are not considered to be equivalent to air conditioning as an end-use.

Table 3: Energy end-use categories and technologies considered in modelling exercise.

Parameter	Source
Population	Base Population Data – China Statistical Yearbook (1992) Population Projections – United Nations (1995)
Residential Energy Use	Energy Shares, Energy Consumption – Feng Lui (1993), Qiu Daxiong et al. (1994) Energy Efficiency – Fuqiang Yang (1997), Peters (1997)
Urban Land-Use	Housing Stock Projections – Siwei Lang and Fan Youchen (1990) Current Land-Use Trends – Leaf (1995), Gaubatz (1995) Existing Buildings Structure Characterisations – Lang Siwei et al. (1992). New Building Construction – Treister (1987)
Transportation	Projected Vehicle Growth – Stares and Liu Zhi (1996) Mode Shares – Qing Shen (1997) Rate of Vehicle Possession – China Statistical Yearbook (1992)
Land-Use Energy Relationships	Transportation – Dunphy and Fisher (1996), California Energy Commission (1993) Building Heating – Keyes (1976) cited in Owens (1986)

Table 4: Key data sources for modelling exercise.

which indicate the relative technology penetration in each development class for each end use. Overall emission rates (t/GJ) are determined for each development class *(Development Class Emission Rates)* by multiplying each technology share by its respective technology emission rates and summing them for all technologies in that development class. Present and future per capita yearly energy consumption (GJ/capita/year) values are calculated for each end use. An *Energy Consumption Multiplier* is calculated for each development class which estimates the difference of development class on overall energy consumption due to non-technology factors (i.e. the effects of shared walls; changes in trip generation). Total per capita emissions (GJ/capita/year) for each development class are finally determined by multiplying development class emission rates by the energy consumption multiplier and the per capita energy consumption values.

In order to reflect regional and economic differences in energy use and supply, the following distinctions were integrated into the above modelling steps: city size, GNP and climate. Climate was chosen because of its effects on the demand for heating and cooling energy. Per capita GNP is incorporated because regional differences in wealth are significant in China, and rising incomes have been a key factor in the surge of urban residential energy use and car ownership. It also reflects both the ability of urban areas to afford certain types of investment such as public transportation and differences in personal consumption between urban areas. City size is used because cities over and under one million are quite different in terms of urban form.

3.2 Data Sources

The projections are based on numerous data sources, including considerable information found in published refereed studies in this subject area. Official Chinese data are used in some cases where internationally verified data were not available. In some instances, we have made quantitative interpretations of qualitative trends, particularly in the case of land-use characterisation where the availability of hard data is limited. Key data sources are described in table 4.

3.3 Results of Model Run

The results broadly suggest that CEM strategies may bring about significant reductions in air emissions, particularly those affecting local air quality, as Chinese urban areas become more and more motorised. Impacts are shown by emission type in fig. 1 to 4. Contributions of each end use to total emissions are also shown to give a sense of the growth of each end use, and to show what end uses are contributing most to reductions in emissions. CO_2 savings are 14.4% between the CEM and the DCT future scenarios. CEM measures have an equally significant effect on particulate emissions (14.0% savings), a major health concern, and an even stronger effect on NO_X emissions (40.4% savings). SO_2 emissions are relatively less affected (9.7% savings). The effects of CEM in this modelling exercise are midterm. Given the even longer lifespan of infrastructure, the environmental benefits would further increase over the long term.

Transportation is strongly affected by the CEM initiatives modelled in this exercise. Major emission reductions, particularly in NO_X, result from a relatively small reduction in automobile acquisition, from transportation management and land-use planning. Changes in cooking fuels contribute most to total particulate reductions. Cooling does not figure strongly in the future scenarios for China as a whole, since this end use accounts for a very small percentage of all emissions.

The model results should be interpreted as an exploration of the magnitude of benefits to air quality and CO_2 emissions that could occur if CEM strategies are adopted. The model is

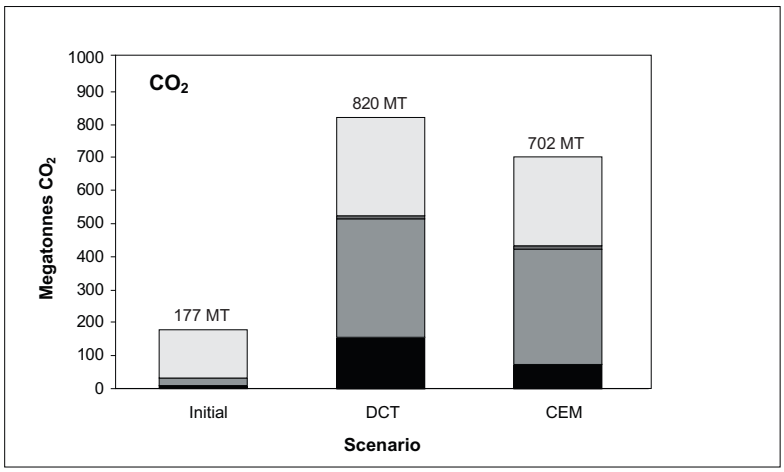

Fig. 1

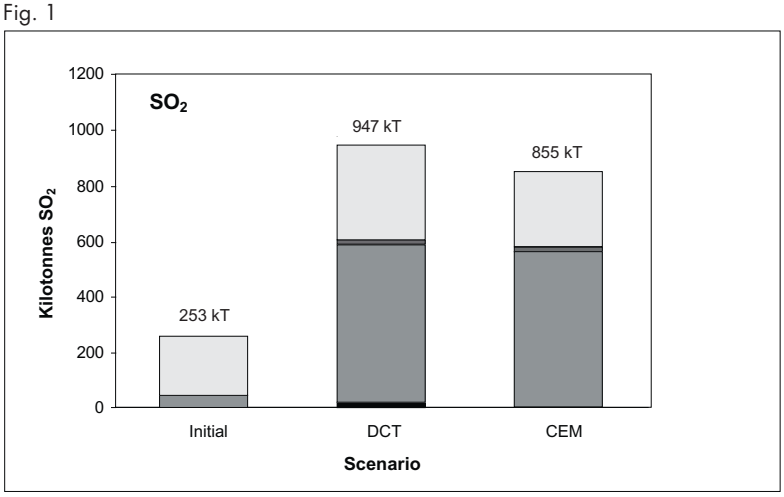

Fig. 2

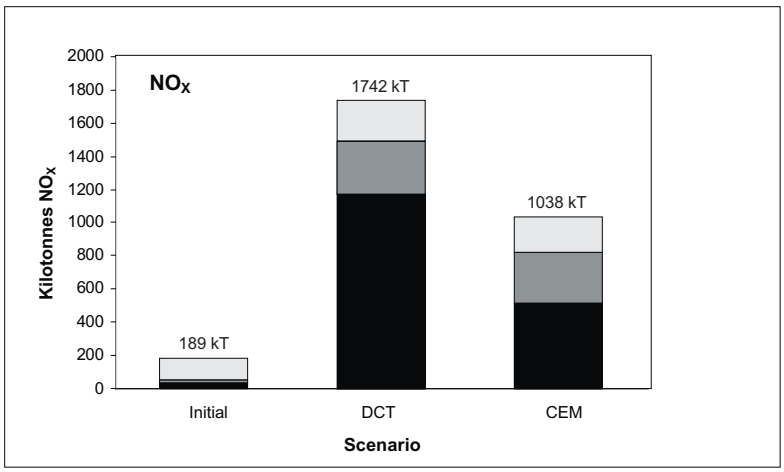

Fig. 3

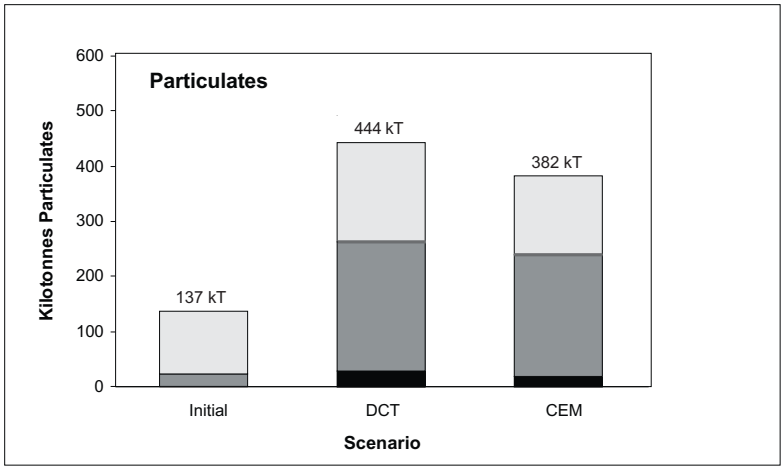

Fig. 4

Fig. 1: Total annual CO_2 emissions for the initial period and future scenarios (2015).

Fig. 2: Total annual SO_2 emissions for the initial period and future scenarios (2015).

Fig. 3: Total annual NO_X emissions for the initial period and future scenarios (2015).

Fig. 4: Total annual particulate emissions for the initial period and future scenarios (2015).

grounded in data and observable trends; however, the model has simplified many of the complexities found in the actual system. For instance, we assume that the comfort level of different development classes (i.e. low storey compared to high storey) is identical and that the average per capita living space is the same across all development classes. Also, we are not taking into account many of the behavioural aspects of energy use, and we are not considering future changes in coal mix, technological end use efficiency and emission control. In addition, uncertainty is also present in the model due to data limitations. [4] A wide range of parameters in the model were tested in a sensitivity analysis, including the assumed relationship between urban form and energy consumption, assumptions in technology energy efficiencies and coal mix, and energy service demands. It was found that the results are most sensitive to transportation parameters and in particular the projection of motor vehicle penetration. However, refining this parameter further does not affect the conclusion that CEM structuring of urban form will have a positive impact on air quality, but simply when this effect will occur. The gains of structuring urban land form favourably now, even if motorisation is slower, will still be realised.

3.4 Costs

An important consideration in pursuing CEM strategies is cost, and in particular, cost in relation to alternative strategies that would also reduce greenhouse gas and local air emissions. Though costs are not explicitly measured in this modelling exercise, some speculations are offered.

Moving to a more co-ordinated, mixed land-use is likely to lead to total cost reductions in providing and servicing basic community infrastructure (roads, sewers, electricity), and will lower total energy costs because of efficiency improvements. In addition, com-

bining CEM oriented land-use changes with transportation, gas and/or district energy infrastructure investment would increase the cost effectiveness of those investments. Cost analysis of CEM measures in a Canadian context have shown costs to be low, and even positive per tonne of emission reduced (Jaccard et al.,1995; Sadownik, 1999). We speculate that costs would be somewhat higher in China relative to Canada because large cost savings in those studies come from changes in urban form from single detached housing to multi-family housing, a change that is much less applicable to China. In addition, the China-specific CEM strategies outlined in this paper call upon increased penetration of technologies (gas cooking infrastructure, district energy) that are considerably more expensive than the alternative (coal stoves).

Cost evaluation would also be affected by issues such as prices (the price of coal; whether steam/heat prices are reformed), from who's perspective cost is evaluated (i.e. social or private), and the types of costs that are included. CEM strategies would likely lead to many favourable non-cost benefits – such health improvements, employment spin-offs, and reducing the loss of agricultural land – which if monetised would reduce the cost. Nevertheless, it can also be argued that the full cost to society of moving to a CEM world should include any lost consumers' surplus, for instance any lost advantages such as privacy, speed, prestige and comfort that are associated with particular transportation choices. [5]

4 Implementation of CEM

Current residential and transportation energy practices have led to critical and deteriorating air quality conditions in a growing number of Chinese cities. In many respects, local environmental pollution problems are weighted by government much more than global problems, and efforts to address these problems will gain strong public support (Lin Gan, 1998). This is a compelling basis for the adoption of CEM strategies. The successful implementation of CEM will rely on the ability to integrate urban planning and energy planning at a state and local level, and on creating policies that can fit into developing political economy relationships. The emergent nature of the market system is favourable to incorporating, from the start, tools and processes that can implement CEM objectives, such as regulation, market incentives, education/information and targeted public investment.

The ability to implement CEM and realize the benefits suggested in the modelling exercise also relate specifically to the institutional structures that have developed around land-use planning, energy planning and transportation planning. Given China's huge population, regional and local dynamics, and uneven pace of change, existing and developing institutional structures defy generalised descriptions. Nevertheless, we draw on a considerable body of literature to offer a few insights into how CEM might best be implemented.

4.1 Land-Use Planning

At the highest level, urban form is determined through strategic plans ("master plans") which set out each city's identity as well as a plan for its development and construction. When the plan is approved it becomes a statutory document – all development is to coincide with this plan. This would suggest that China could easily influence urban development for energy objectives. However, new development can be disjointed and poorly planned, while inner-city development can be scattered and unconnected, all of which would indicate that actual development differs from the planning process outlined. Development control may be relaxed in order to increase the attractiveness of particular sites for development, so that economic development and short-term growth can be accelerated (Gar-on Yeh, Fulong Wu, 1995). Land is often developed on the periphery of urban areas because acquisition of land for leasing or the development of commercial housing in the city centre involves much time-consuming bargaining. The structure of economic management and development has also caused economic activities in a spatial unit to be compartmentalised according to structure of the bureaucracies involved. There is currently little in the way of checks and balances to curtail the discretionary power of high level government officials in making land development decisions (Mee Kam Ng, 2002). Regulations often go unenforced [6] and an efficient allocation of development resources is impeded by ambiguous property rights (Jieming Zhu, 2002).

In order to reduce arbitrary planning decisions and illegal land transactions, a stronger legal framework needs to be applied including a clear definition of property rights. The current trends towards a leasehold land system rather than a system based on private land ownership is favourable to the implementation of CEM objectives, because the state can more easily specify terms such as building restrictions and design, height, arrangement of structures and permitted land-use. Existing building approval processes could also be expanded to include consideration of the use of microclimate, landscaping, and the location of paved surfaces.

A master planning process could still be a powerful means of encouraging sustainability objectives in urban development, should it be integrated more readily into the actual municipal development approval process by changing its frequency, flexibility and its content. Removal of the requirement of State Council approval would discourage static plans and adaptive management principals can be incorporated into the process to allow for more flexibility. For instance, a mechanism could be created that allows actual development to be "fed back" into the plan including the nature, location, and phasing of infrastructure investments, and the requirement for new planning to be done to reflect these changes. Hong Kong and Singapore, for example, have flexible macro structure plans that allow for such feedback (World Bank, 1993). Land-use objectives can also be encouraged through policy instruments, such as market incentives, that are appropriate to the government's evolving role towards the emergent market economy.

4.2 Energy Planning

Energy planning needs to be able to identify energy efficiency and alternative supply investment opportunities appropriate to local conditions, and that make sense from an economic, social and environmental perspective. They then need to encourage the efficient development of these opportunities. Many Chinese national energy policy goals are in keeping with the CEM strategies – for example, China has stated policies of encouraging co-generation, district heating systems and clean coal technologies such as coal cleaning and coal gasification, as well as equally weighting consideration of energy exploitation and conservation projects. Nevertheless, the actual implementation of these policies has not fully realised their intent.

CEM strategies require the flexibility to comprehensively evaluate energy projects, which is a challenge in the existing institutional arrangement. Different ministries have different processes and guidelines to assess projects; there is no single intra-ministry process regarding project assessment. Sustainable energy supply could be encouraged by the adoption of consistent and transparent procedures across government ministries and by evaluating options within an integrated resource planning framework. In considering projects, it is important that the benefits and costs of all available supply and demand-side alternatives and their respective impacts on the local environment are thoroughly studied.

Greater co-ordination of policies and investment across energy subsectors is very important to implementing CEM objectives. This could be accomplished through the addition of integrative mechanisms or through institutional restructuring. For example, provincial and local energy bureaus could be created that combine existing separate bureaus. Co-ordinating bodies free from the competitive dynamics that often characterize interagency communication could be introduced within the bureaucratic structure.

Plan allocations of energy at below market prices (in effect acting as energy subsidies) still account for a substantial portion of energy procurement, providing weak incentives for investment in energy conservation. In order to encourage future energy conservation, current subsidies for energy consumption should be eliminated. Financial incentives, which have been used in the past to encourage efficient and renewable energy supply, also need to reflect the significant changes to energy development and financing. For example, banks, which have gained considerably more control in financing, have little incentive to invest in energy efficiency (Zhong Xiang Zhang, 1995). Lin Gan (1998) argues that energy conservation is unlikely to be favoured by most investors, unless strong policy support is in place. Policy measures could include encouraging commercial banks to offer preferential interest rates for energy efficient and alternative energy technology investment, reinstituting the tax exemption for delivered heat, and adjusting the tax treatment of energy equipment expenditures to recognise that most renewable resources have no fuel costs to be deducted from revenues for tax purposes (Byrne et al., 1996).

4.3 Transportation Management

China currently has a window of opportunity to establish effective transportation policies before motorisation is too far advanced. Faced with considerable pressures of motorisation and population growth, many cities are active in promoting transit, for instance, bus priority measures have been established in Kunming, Shenyang and Beijing, and motorcycle and car licenses are auctioned in Shanghai. Nevertheless, the Chinese government is investing heavily in motorisation and car ownership is growing significantly. Specific engineering and technical means are often emphasized in domestic traffic research. For instance, Chinese master plans frequently have major outlines for urban road networks which go well beyond the scale of expressway construction in existing developed motorised cities across the world (Stares, Liu Zhi, 1996). Pursuing alternative transportation approaches is complicated by fragmented responsibilities for municipal transport, including the lack of uniform regional planning and conflicting objectives between municipal departments (Paaswell, 1999).

The development of inter-agency teams at the municipal level, and where applicable the regional level, would allow for more comprehensive and holistic planning that includes consideration of demand-side management and land-use planning, as well as traffic management and engineering traffic solutions. It is particularly important that a wide range of possible strategies are evaluated using multiple criteria to determine the most suitable strategy. The United States' success in changing transportation planning from highway-oriented to multi-modal planning through its Transportation Efficiency Act for the Twenty-first Century (TEA-21), may be an example that China could follow. [7]

Insecure financing is a significant obstacle for public transport development. Viable fares and an appropriate regulatory framework for private participation are essential for long-term viability of the transit system (Chang 1999). Less expensive means of public transportation development could be explored that can be upgraded as funds permit. For instance, support could be given to the improvement of ground public transport which could lead into the development of express buses, busways and light rail transit.

China is unique compared to other countries in the role of the work unit in securing housing for its employees. However, this role has undergone significant changes in the past decades, so that work units no longer determine directly where their staff and workers live, but instead purchase housing for workers in comprehensively developed housing projects which are developed by the municipality's development companies (Garon Yeh, Fulong Wu, 1995). The focus is turning to municipal control over business siting. It is critical that the relationship between employee housing and the workplace location is recognised in new planning processes, so that future travel demand can be reduced. Approaches could include encouraging

development companies to co-ordinate with work units that have a demand for housing at the initial development stages of their projects. Or, if projects are already being established, preferential treatment could be given to work unit housing demands that are in closest proximity to the development.

5 Conclusion

This paper can be viewed as a *departure point* for exploring the relevance of CEM to China. The modelling, though it may be simple in its method and data sources, is illustrative of the magnitude of benefits that could be realised in a country that, like China, is in a position of major increases in urban growth and energy use. Many of the issues raised in this paper could be taken up in greater detail in future research. China has been treated as a homogenous entity, and the unique variations in urban planning and the development experiences of different urban centres have been overlooked. A study exploring the detailed application of CEM to a specific urban community would be an important *next step* in investigating this issue, both in terms of quantitative analysis and in terms of the social, political and implementation issues. It would also be useful to broaden the model to evaluate costs and to consider other CEM strategies such as the facilitation of renewable energy technologies.

Because urban form will orient energy patterns far into the future, CEM should be an important component of a sustainable energy strategy in China, and can complement conventional energy analyses and strategies. In many ways, China is well suited to adopting this perspective, particularly in being able to shape market forces before practices become entrenched. The ability to control land development is potentially stronger given China's *conditionally-structured* property rights. Other advantages include the closer ties that currently exist in China between work and residence location due to the continuing organizational role of the work unit, and the existence of fairly active environmental directives that influence energy policy making. Indeed, China already approaches many energy issues with a CEM angle, for instance through its strong focus on district energy and growing interest in renewable energy development. Furthermore, the municipality is already part of the institutional structure that oversees energy provision which can complement its role as urban planner.

Nevertheless, many key challenges need to be overcome. Economic opportunities are short-term and immediate, and are difficult to reconcile with longer-term sustainability concerns. And even when policy and legislation are formulated, they need to be supported and enforced, and different government agencies and levels of government co-ordinated, so that what unfolds is indeed guided by policy objectives. This is particularly difficult when local authorities lack resources, are ineffective and/or vulnerable to corruption.

These challenges are not unique to China and are neither straightforward nor simple to overcome. Nevertheless, because urban design measures can be simultaneously supportive of other community objectives, there are strong motives for policymakers to pursue this path. Practices that reinforce sprawled land-uses in China are not deeply entrenched, in contrast to countries where CEM analysis has developed. It is more fruitful to shape and mould urban planning and transportation towards sustainable ends, than to undo fifty years of urban structure that reinforces unsustainable energy use. Likewise it is easier to hinder acquisition or use of the car that has not yet been acquired, than to alter an already existing high per capita ownership pattern.

Notes

[1] This specialisation did not occur before now in China. During the Maoist period, urban planning was limited, and work units provided not only employment, but housing and other services to its workers, resulting in a mixed-use urban form within walled compounds.

[2] The demand for air conditioners is rising considerably. If growth in urban areas follows Hong Kong's example – electricity consumption for air conditioners rose 535% from 1979 to 1993 (Lam, 1996) – then energy use for this end use may be considerable in the future.

[3] Traditional bus services are becoming particularly unattractive. Bus speeds are falling from congestion, and riders are leaving for other modes (Chang, 1999).

[4] For a fuller discussion of these uncertainties, and more detail about the modelling exercise in general, see Sadownik (1998).

[5] For a fuller discussion of this and other costing issues see Jaccard et al. (2002).

[6] For instance, the Regulations for Planning and Conveyance and Transfer of Land Use in State Owned Urban Land, which stipulate land use requirements such as density and siting requirements, are often unenforced (Qingshu Xie et al., 2002).

[7] In order to receive federal infrastructure funds, TEA21 require cities to establish inter-agency organisations to carry-out long-range intermodal transportation planning and to submit annual plans for federal approval that meet flexible sustainability criteria.

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Small City, Big Solution?

China's Hukou System Reform and Its Potential Impacts

The most significant move towards breaking down the barrier of China's existing household registration system (or hukou in Chinese) was taken in late 2001, when the Chinese government allowed its peasants to become legal urban residents in all small cities and towns.
This is a very important hukou reform, and its impacts will be enormous and multidimensional. The first impact is on the existing occupational segregation between migrants and local workers. This paper argues that both the phenomenon of occupational segregation and migration settlement related to native place ties will become less relevant due to the small-city-free policy. In addition, it addresses the potential impacts of this small-city-free policy on urbanisation and the urban labour market. Finally, it attempts to explain the reasons why the Chinese government set up the small-city-free policy and assess the potential impacts of the small-city-free policy on China's urbanisation pattern/urban system, and potential competition between those new migrant workers and local workers in the labour markets. It concludes that the small-city-free policy is a first significant step towards decontrolling population mobility. Its impacts need more research.

1 Introduction

Rapid social and economic changes since 1978 have gradually broken down the barrier of China's existing household registration system (or hukou in Chinese). The most significant move was taken in late 2001, when the Chinese government allowed its peasants to become legal urban residents in all small cities and towns as long as they can prove that they have a legal static dwelling place and a stable source of income (hereafter we call it small-city-free policy). These migrants are entitled to the same housing, medical, education and employment benefits as local urban residents. They are also entitled to contracted farmland in their home villages, or they can transfer it to others (http://www.china.org.cn, December 24, 2001).

This is a very important hukou reform, and its impacts will be enormous and multidimensional. Although movement to small cities and towns was never as tightly monitored as movement to large cities, a freer population mobility policy will no doubt also attract large numbers of peasants to small cities and towns in the hope of becoming legal urban residents. This movement will reshape China's urbanisation patterns. It represents not only a simple change from agricultural hukou status to urban hukou status, but has several implications which this paper will discuss.

The first impact is on the existing occupational segregation between migrants and local workers. Before the small-city-free policy was introduced, rural migrants in urban areas (called "floating population") were not granted legal urban residency status, even though they had worked and resided in urban areas for many years. They had to take 3-D jobs (dirty, demeaning and dangerous), which were considered to be inferior by urban residents (Roberts 2000; Wu and Li 1997; Meng 1996). They did not pose any serious competition to local workers for urban non-3-D jobs, which were protected by the municipal government for locals. Meng's (2000) survey samples show that rural migrants in Chinese cities appear to have little impact on open urban unemployment because less than 12 percent of migrants are employed in the state sector and these migrants account for 3.5 percent of the total state sector employment. There was a clear occupational segregation. This paper argues that this occupational segregation will disappear when migrants become permanent/legal urban residents.

Secondly, the degree of dependence on home town ties for job access and selection of places to reside will become less important when migrants become legal urban residents. Without legal urban resident status, the floating population in Chinese cities gained access to urban jobs mainly through "special channels" (Zhao 2000). My field interviews in the last few years show that most of the floating population had job offers before they moved to urban areas, and many of these jobs were introduced by migrants' friends from the respective home town – or native-place ties (Zhao 2001). Massey et al.'s observation that "migrant networks are sets of interpersonal ties that connect migrants, former migrants, and nonmigrants in origin and destination areas through ties of kinship, friendship, and shared community origin" holds true for China's floating population (Massey et al. 1993: 448). Floating population workers not only accessed jobs via such social networks, but also migrant accommodation or migrant settlements such as the areas of Zhejiang Village, Xinjiang Village, and Henan Village, as well as Anhui Village in Beijing (Davin 1999; Ma and Xiang 1998).

Therefore, one of the arguments of this paper is that both the phenomenon of occupational segregation and migration settlement related to native place ties will become less relevant due to the small-city-free policy. In addition, the potential impacts of this small-city-free policy on urbanisation and the urban labour market will be addressed. The first section outlines the changing hukou system and urbanisation processes over the years, as well as the impacts of the rigid hukou system. Then, an explanation as to why the Chinese government set up the small-city-free policy is given, followed by a discussion of the potential impacts of the small-city-free policy on China's urbanisation pattern/urban system, and potential competition between those new migrant labourers and local workers. It concludes that the small-city-free policy is a first significant step towards liberalising population mobility. Its impacts, however, need more research.

2 Strict Hukou System and the Emergence of Floating Population

The hukou system was introduced in 1958 and became the Chinese govern-

Year	Policies or Regulations	Implication for population mobility
1958	Hukou Registration Regulations of PRC	For the first time, a concept of approval system for rural-to-urban migration was introduced in China.
1963	Agricultural hukou and non-agricultural hukou were introduced	Emergence of dual society: highly subsidised non-agricultural (urban) population with entitlement for food rations versus agricultural (rural) population.
1975	Amendment of Constitution – abolished the items related to freedom of population mobility	Legalisation of the strict control of population mobility.
1977	Regulations for Hukou Change	Detailed tough regulations towards migration from rural to urban and from small cities to large cities. If a rural hukou holder married an urban one, the rural one must work in the rural area and child/children were also rural hukou.[1]
1980	Official urban development strategy was introduced – "Strictly control the growth of large cities, rationally develop medium-sized cities and encourage development of small cities/towns"	Population mobility control was linked with national urban development strategy.
1984	New regulations which allowed peasants to work and reside in small towns, but they should find jobs and provide food for themselves	The first step toward relaxation of the hukou system: peasants were allowed to work/reside in small towns.
1992	State Council established Document Drafting Group for Hukou System Reform	Formal organisation in central government was established to deal with hukou reform and to relax population mobility control.
1993	Proposed Hukou Reform in Small Towns	Feasibility study stage for small town hukou reform.
1997	The Ministry of Public Security started pilot work in reforming the existing hukou system in 552 small towns and small cities[2]	Experiment Stage of Hukou Reform: Peasants were allowed to become legal city/town residents in these towns and small cities.
1998	Ideas for fixing a few big problems in current hukou management	The policy allows urban returnees'[3] spouses and children to move to the city; aged rural-hukou parents to move to city where their children live; rural hukou holders to move to urban if he/she marries an urban hukou holder; peasants to become legal urban residents if they invest in the city or purchase housing property in the city.
2001	Small-city-free policy	Peasants are allowed to move to towns and small cities.

1 People's Daily, 29 August, 2001.

2 State Family Planning Commission of PRC, materials are available at www .sfpc.gov.cn/EN/news 20011028-1.htm.

3 Urban returnees refer to those urban youth who were sent down to the countryside and married peasants during the cultural revolution. After 1978 they were allowed to return to their home cities but their rural spouses and children were left behind. The new regulation allowed these rural spouses and children to move to the city legally.

Source: www.macrochina.com.cn/zhzt/000093/003/20010823017257.shtml

Table 1: China's hukou related policy changes and the implications from 1958 to 2001.

ment's tool to control rural-urban migration. According to the hukou system, all families were tied to a particular place and divided into non-agricultural (urban) or agricultural (rural) categories, and each person was assigned either rural or urban status with little hope of changing this registration (Wan 1995). Basic necessities such as grain and cloth were available only in strictly rationed amounts through the work units (danwei in Chinese) or collectives to which individuals were officially assigned. Population mobility was strictly controlled: peasants were unable to move to urban centres and urban workers were tied to their particular jobs and accommodation through their work unit. Therefore, the hukou system made China one of the most static societies in terms of population mobility in the world.

As table 1 shows, from the late 1950s up to the late 1970s, China's hukou related policies became more and more restrictive. In 1975, the Chinese people's freedom of mobility was removed from China's Constitution. The impact of the strict hukou system during the period from 1958 to 1978 on the society was enormous. First, China had experienced counter-urbanisation in the 1960s and early 1970s. Its urbanisation level dropped from 19.7 percent in 1960 to 17.9 percent in 1978 (see fig. 1). This drop was mainly due to restricted rural-to-urban migration as well as the "sending-down programme" – urban youth were sent to rural areas for re-education (Bernstein 1977). Chan (1994) called the hukou system during this period the city's "invisible wall". Rural-urban linkage was artificially cut off (Knight and Song 1999; Wang 1997a; 1997b).

Deng Xiaoping's open door and reform programmmes, introduced since 1978, have called for more cheap labour in urban areas, especially along the coastal regions. Peasants have gradually been allowed to work and reside in urban areas and have been referred to as the floating population. Their movements are mainly rural-urban but also rural-rural, urban-rural and urban-urban, and cross local, county and provincial borders. Some moves were

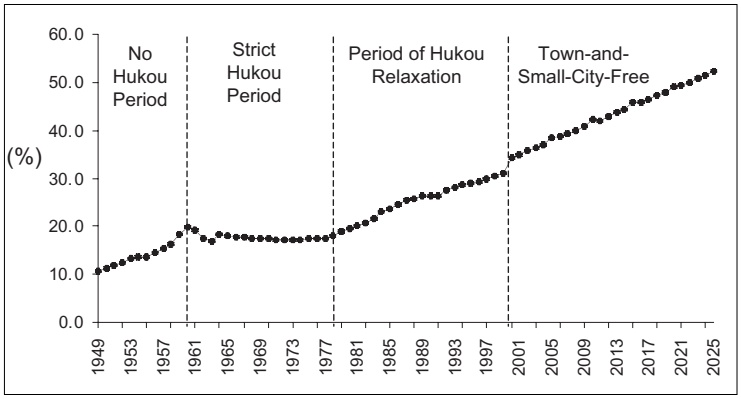

Fig. 1: China's urbanisation level during different hukou periods, 1949 to 2001.
Sources: Urbanisation data from China Statistical Yearbooks (various years); data in 2001 from People's Daily, June 7, 2001; post-2001 data are from http://www.unhabitat.org.

temporary and seasonal, while others are semi-permanent or permanent, but in either case the movers come under the classification of floating population, because they are not recognised as legal urban residents by the governments (Cai 1998).

Without legal urban residency permission, the floating population can survive in cities mainly due to the development of the urban free market (Chan 1995). Rapid development of the urban private economy also enables the floating population to access goods and services outside official channels. A peasant working in the urban area no longer needs to bring along a supply of grain and she/he can always buy it on the open markets (Chan 1996).

The government's liberalisation of population movement has been carried out gradually. Since the early 1980s, the Chinese government has gradually allowed its citizens much freer mobility, but such relaxation has been incremental, even though it is argued that the emergence of the floating population in urban China is associated with a gradual loosening of state control over population mobility (Fitzpatrick 1999). However, it is further suggested that the emergence of the floating population is not the explicit aim of government policies but a by-product of the economic reform and open door policy (Chan 1995).

The pace of relaxation of the hukou system, as indicated in table 1, has been very slow, and lifting the restriction on peasants' mobility has never been the Chinese government's top agenda. It can be argued that peasants in Chinese society have been the soft potato. They have been viewed as being less vocal and their interests and political views have often been ignored. Discrimination against the floating population has been widely reported. The most noticeable problem is migrants' lack of political rights and long-term position in the local community. Moreover, migrants found themselves subject to local restrictions. They were forced to pay a series of fees (Yang 2001). Migrant children in China's big cities have struggled to find places in school. For many, the unlicensed route is at best, the only option. These children have a sense of inferiority wrought by their second-class status (http://www.unesco.org/courier).

3 Why Small-City-Open-Door Only?

There is no research as to why China adopted the small-city-free policy and what its impacts will be. Based on available information from various sources of Chinese media and government reports, this paper argues that at least the following are the key reasons:

- It has been gradually realised that freer labour mobility has become a positive factor in China's overall economic development and that the floating population have significantly contributed to China's urban development. China's stepped-up industrial production, an expanding number of non-state enterprises, and modernisation of urban infrastructure all require a huge number of cheap labourers (Logan 2002; Chan 1995).

Rural migrants have transformed the cities of China. Everyone who visits Chinese cities observes rural migrants' contributions to the development of Chinese cities. Not only have they built skyscrapers, worked in assembly lines (either foreign-owned or joint venture firms), keep "Made in China" products cheap, but they have also provided a variety of urban services and greatly eased the lives of official urban residents. They prepare and serve food sold in sidewalk stands and fine restaurants, decorate houses, fix bicycles and plumbing, sell vegetables, clothes and a variety of other commodities in markets that previously did not exist, and do the hard and dirty work in factories, transport and sanitation (3-D jobs) (Qian 1996). For example, in the mid-1990s, construction in Beijing, one of the city's most vibrant industries, was dominated by more than 800,000 migrant labourers and about 80 percent of Beijing's housekeepers, restaurant staff and vegetable market sellers were floating population (Chan 1995).

- Speeding up urbanisation is considered to be one of the important driving forces for sustaining economic growth in China. After two decades of rapid economic growth, one of the challenges China is facing is how to maintain this growth and fix the problem of sluggish domestic demand (Webber, Wang and Zhu 2002). Urbanisation is thought to be an ingredient of further development. This idea was clearly stated in China's 10th Five-Year Plan for Economic and Social Progress (2001–2005). The government's small-city-free migration policy is to expand small cities and towns and make steady progress in urbanisation in order to increase job opportunities and sources of income for farmers. The small-city-free policy is intended to promote the transfer of redundant rural labour, as well as stimulate infrastructure construction and the development of the real estate industry in small cities and towns (Peoples' Daily, September 24, 2001).

It should be pointed out that the Chinese government expects different size cities to perform different tasks. For example, small cities and towns are expected to: (i) provide various types of services for agriculture and farmers, (ii) develop advantageous labour-intensive industries, and (iii) support industrial development in central cities. The suburbs of central cities (central cities are those

large cities with urban populations over two million) are expected to develop export-oriented, ecologically sustainable agriculture. And the central cities themselves are to develop high-tech industries and manufacturing, and other industries with high added-value and great employment capacity (http://www.china.org.cn). However, rural migrants in medium and large cities are still not allowed to become legal urban residents.

- Why not big cities? The hukou reform has not been carried out with undue haste in large cities and only some cities have given urban hukou to those peasants who have invested or purchased housing in the city. This policy was called "Business Investment for Urban Hukou and Purchasing Commercial Housing for Urban Hukou," which was issued in 1998 by the Ministry of Public Security of PRC (http://www.china.org.cn December 24, 2001).

The reasons for not allowing all rural migrants to become legal urban residents in large cities are both political and economical. On the one hand, the big concern is the existing urban subsidy and benefits. Without urban hukou, rural migrants are denied the benefits (housing, medical, education and employment) available to urban hukou holders, even if they live and work in cities. It is also true that per capita public welfare levels in large cities are much higher than in small cities. Therefore, as long as the urban subsidy exists, it is temporarily unsuitable and politically sensitive to pursuing the policy of decontrolling the hukou system in large cities. The financial implication is that each additional urban hukou holder in a large city means one more financial burden for municipal government.

On the other hand, urban residents' complaints are the important political reason. Despite the contributions of rural migrants to urban development being recognised by the government in the recent years, urban residents in large cities blame the floaters for crowding the railway stations and buses and congregating in groups while waiting for work in street-side labour markets (Solinger 1999; Wu and Li 1997). Despite some sympathetic notes, the tone of coverage of migrants in the Chinese press was predominately negative until the small-city-free policy was implemented in 2001. In addition, most urbanites associate rural migrants with chaos, crime, violence, high fertility and illicit sex, and they are presented as threatening to social stability and law and order in various ways (Davin 1999). To many urban residents they appear as foreigners in their midst (Roberts 2000). More recently, they are blamed for taking jobs that could otherwise be filled by those laid-off from failing state industries. Links are often made between migration and urban unemployment. Urban residents believe that the low wages and profits that migrants are willing to accept are seen by urban workers as unfair and invidious competition. For example, a survey in the mid-1990s found that 74 percent of Shanghai residents held migrants responsible for at least three of the following four problems: crime, transport, employment and environmental degradation (Solinger 1999).

The floating population are also blamed for placing great strains on the existing urban infrastructure and services, such as water supply and housing. Large cities, such as Beijing, Shanghai and Guangzhou, are simply ill-equipped to cope with the needs of the millions of people from the floating population. In Beijing, the floating population accounts for about a quarter of its total population, in Shanghai about one third (Webber, Wang and Zhu 2002). It is believed that the grade of infrastructure construction is much higher in large cities, and the amount of government public expenditure needed for an increase of every urbanite is large. It is financially impossible for the municipal government to support the large number of newly-added legal urban residents (People's Daily, September 24, 2001). Therefore, the Chinese government is making an effort to channel rural migrants into small cities and towns. It is expected that this will not only help cut unemployment in villages, but also accelerate the urbanisation process. This is not to say that small cities and towns have better labour absorbing capacity. In fact, many Chinese scholars believe that medium and large cities are more capable of absorbing labour due to their better-developed tertiary sector, but the government as well as some Chinese scholars worry about migrants' pressure on large cities and the inherent social and political risks.

4 Potential Impacts

The small-city-free policy will reshape China's rural-urban migration pattern and have a range of impacts, although it is too early to confidently predict these impacts. This paper addresses two important questions: (i) whether new migrants will compete with locals in urban labour markets, and (ii) how the migration pattern will be changed. It is argued that new migrants will better compete with locals in urban labour markets based on equity, qualification and skill, and the existing occupational segregation will disappear.

Before the small-city-free policy was implemented in late 2001, there was a debate as to whether the floating population competed with local workers in urban labour markets. This was a very sensitive issue (Yang 2001; Dutton 1998). As mentioned above, many locals, including the media, believed migrants did compete with locals. It was believed that urban labourers were in a disadvantaged position and that low-skill urban jobs seldom met minimum standards because the floating population had drastically altered the urban labour market and was willing to do almost anything. Therefore, the market for unskilled jobs has become a contest to see who can endure the most, with the floating population usually "winning". Being from a farming background, the migrants did not know much about labour contracts, and they were usually not concerned about benefits such as health insurance and pensions (Iredale 2000). As such, rural migrants' "advantages" over urban labour, including urban laid-off workers, were mainly due to the fact they accepted low wage jobs (floating populations' monthly wage

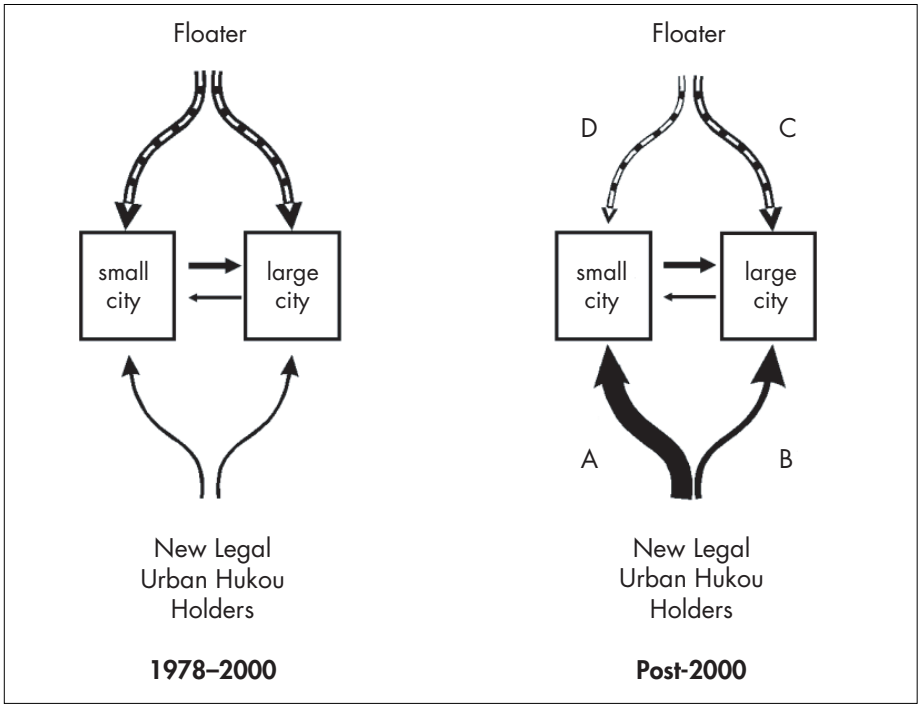

Fig. 2: Changing migration patterns in China: 1978 to 2000 and post-2000 periods.

was about 56 to 64 percent of those of urban residents) and "they can bear hardship and are easily manageable" (Knight, Song and Jia 1999: 91). Chan (1995) concludes that the migrant workers are happy to work for low wages, because wages low by urban standards are very high by rural standards (Hare 1999).

Most researchers and observers, however, do not believe there is serious competition in urban labour markets between migrants and locals. Knight and Song (1999), analysing a survey of workers in urban enterprises, found sharp segmentation between urban residents and rural migrants due to the unique political and institutional arrangements in China which gave urban residents privileged access to secure employment at above market-clearing wages and which controlled the flow of peasants to the cities, allowing rural migrants to fill only the jobs that urban dwellers did not want (Appleton, Knight, Song and Xia 2001). Obviously, there is a clear occupational segregation. For the floating population, employment options were limited and the majority of migrant workers took up the 3-Ds jobs.

However, it can be argued that when rural migrants become legal urban residents in small cities and towns, the historically segmented nature of urban employment in China will break down and the jobs of the migrants and the urban residents will become more interchangeable. As mentioned above, occupational segregation by residency was a phenomenon when rural migrants' residency rights were denied and they were treated as second-class citizens. Now they may not accept underpaid jobs, nor are they likely to be willing to "win" at a wage disadvantage by comparison with established urban residents. The permanency of migrants' residence status will offer them more access in job hunting and grant more confidence in wage bargaining than when they were "floating" or temporary illegal urban residents in the period preceding the small-city-free policy.

This is different from the evidence from such places as Australia about the effects of migration on the labour market. To many immigrants in Australia, the legality is not the central issue – the central issues are about difference, and especially about English language ability (Cobb-Clark and Connolly 2001). However, the hukou changes do strengthen the hand of Chinese rural migrants in urban areas and the language barrier is not a problem (even many rural migrants prefer to speak local dialect but they can all speak Mandarin). The legality will erode the dividing line between urban native born and migrants, even though not all migrants change their jobs immediately after becoming urban residents because they still need jobs and they are used to different kinds of work.

The second set of impacts is related to rural-urban migration patterns. It is not difficult to make a prediction that the migration pattern may be changed due to the introduction of the small-city-free policy. As fig. 2 shows, compared with the period 1978 to 2001, the post-2001 period will witness these four main streams of population mobility: Group A will form the largest group among all rural-urban migrants. It includes those rural migrants who directly migrate to small cities and towns and become urban hukou holders. They will change China's migration direction. The migration pattern during the period of 1978 to 2001 was dominated by floaters. Both large and small cities were flooded by the floating population. Only a small proportion of rural migrants became urban hukou holders. However, the small-city-free policy will attract more and more rural migrants. So far, the response to the policy has been very active. For example, during the trial period for the small-city-free policy (1996 to 2000), Zhejiang Province's 105 towns and small cities were selected as pilot towns and small cities to practice the small-city-free policy. During that period they had absorbed over 400,000 rural residents, with the population of 80 percent of the chosen small cities and towns being doubled (http://www.china.org.cn. December 24, 2001).

Therefore, the on-going hukou reform will lead to a new wave of migration in China, particularly considering the following developments: (i) economic benefits: rural out-migrants sent home 30 percent of their income which equals 80 percent of rural expenditure on fixed assets, and 3.7 times the state expenditure on agricultural production and administration (Cai 1998); (ii) large number of rural surplus labourers: out of the total number of 490 million rural labourers, 150 million are engaged in farming (but not all full time), 135 million are employed by township and village enterprises (some in small cities and towns), about 50 million are working in cities, and there is a surplus of 150 to 200 million in rural areas (Zhang 1998; Wu and Li 1996); (iii) more surplus labour is inevitable: China's accession to WTO in 2001 will release more rural labour from agricultural activities, according to the predictions by both the Chinese government and scholars (Liu 2001).

	1999		1980	
Super large cities (>2 million)	13	1.9%	7	3.1%
Large cities (0.5–2 million)	73	10.9%	38	17.1%
1–2 million	24	3.6%	8	3.6%
0.5–1 million	49	7.3%	30	13.5%
Medium-sized cities (0.2–0.5 million)	216	32.2%	70	31.5%
Small cities (<0.2 million)	368	54.9%	108	48.4%
0.1–0.2	248	37.0%	62	27.8%
<0.1	120	17.9%	46	20.6%
Total	670	100.0%	223	100.0%
Designated towns	20,312	–	2,874	–

Sources: Urban Statistical Yearbook 2000; data from 1980 from China's National Condition Analysis and Research Group, Chinese Academy of Sciences 1996

Table 2: Number of cities and designated towns in China, 1989 and 1999.

The immediate impact is that China's urban system will be reshaped largely due to a dramatic increase in the official urban population in small cities. This phenomenon can be called small-city-targeted urbanisation. This urbanisation pattern will further flatten China's urban system (table 2). As stated in table 1, China's official urbanisation strategy since 1980 has been characterised by limiting the growth of large cities and encouraging the development of small cities. The urban system has been increasingly dominated by small cities and towns. For example, the number of small cities accounted for 48.4 percent of total cities in 1980 but for 54.9 percent in 1999. The number of designated towns increased from 2,874 in 1980 to 20,312 in 1999. The implementation of the small-city-free policy will eventually lead to further expansion of small cities and towns in terms of both the number of cities and the urban population.

Group B includes those rural people who will be granted urban hukou in China's large cities. However, they are wealthy or highly skilled labour. They have to buy commercial property or operate a business in large cities. Currently many large Chinese cities like Shanghai, Shenzhen and Zhuhai have regulations according to which anybody who has bought local commercial property can apply for status as a permanent resident; Beijing allows free inflow of technical workers with senior professional titles (People's Daily, August 28, 2001). But they accounted for a small proportion of rural out-migrants until the restriction to migrate to large cities was removed.

Groups C and D represent those members of the floating population in large and small cities respectively. It is difficult to predict how many rural migrants will float to large cites even when legally migrating to small cities and towns is an option for them. But it is certain that a smaller proportion of rural migrants will become floaters in small cities and towns than that in the period from 1978 to 2001. Those who still prefer to be floaters to small cities and town are farmers who are able to commute to nearby small cities or towns daily by bicycle, motorbike or tractor to work or sell agricultural products or may work in small cities or towns during non-peak-farming seasons (but they spend most of their time in their villages).

5 Discussion

China's small-city-free policy offers rural migrants an option to become legal urban residents. This is a significant reform related to rural-urban migration. The Chinese government has realised the importance of urbanisation in its economic and social development. China's last two decades of reform demonstrate that while economic freedom has increased individual mobility, mobility has also facilitated economic progress. But the Chinese government is taking a very cautious step towards freedom of mobility.

This partial decontrolling of population mobility raises several further research questions. The first set of questions is related to the geographical pattern of rural-urban migration. If rural migrants are moving to small cities and towns, are they moving to nearby cities and towns or to those in economically prosperous regions such as the deltas of Lower Yangtze and Pearl River or urban corridors of Beijing-Tianjin and Shenyang-Dalian, as these have traditionally been the centres of economic growth (Wang 1998; Lin 1997)? What are the implications for China's spatial pattern of urban growth and urban system? Is this what the government wants?

The second set of questions relates to the nature of migration to small cities and towns. Is there a brain drain from rural to urban areas? Will these wealthier and skilled rural labourers move to small cities and towns permanently? What are the implications for rural development? All these need more research attention.

In the future, China needs to take further steps towards fair and equal rights for its rural population. The small-city-free policy is not ideal. It is not a long-term solution but a first step to address the crux of the migration problem: how to create employment opportunities in an economy in transition to a more market-oriented system. It is understandable that the government must address these problems without causing large social and political dislocations. The question is when the large cities will open their doors to peasants. This has been a politically sensitive issue. Over the last two decades, the Chinese government has reformed its hukou system gradually. One of the key obstacles for free population mobility is dematerialisation of the hukou system. The small-city-free policy was possibly due to several reforms related to dematerialisation of the hukou system – hukou has gradually been separated from material subsidy and privilege with regard to job access, schooling, and social welfare. When the Chinese hukou has nothing to do with employment, schooling, welfare, but only personal identification, then the large cities will accept rural migrants as legal urban residents.

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Inward Investment and the Transformation of Regional Economies in China

From Regional Convergence to Fragmentation between 1953 and 1996

The main aim of this paper is to contribute to the discussion on the relationships between foreign direct investment (FDI) and regional development in China. More specifically, it identifies the fundamentally different modes of development between the Mao and the post-Mao era, and explores the role of inward FDI in order to understand the regional fragmentation of the contemporary Chinese economy. The paper is divided into three sections. First, it illuminates the transformation of regional economies in China towards FDI and the geography of regional inequality in contemporary China. Then, it explores the limits of Mao's strategies for regional development, which led to the introduction of FDI. The final section highlights the way in which the concentration of FDI in new industrial spaces has led to regional fragmentation in the post-Mao era by analysing the extent to which FDI has influenced industrial production, international trade and employment.

1 Introduction

The Chinese economy has undergone a profound transformation since 1978 due to an economic opening up. Economic structures established under China's state socialist system are being transformed by a number of processes which together constitute an attempt to open the door – the introduction of foreign investment, the privatisation of state-owned enterprises (SOEs) and the development of town and village enterprises (TVEs), are all a part of this "transition to capitalism." However, the transition in China has not been as effective as that witnessed in Central and Eastern Europe (CEE). "China's reforms have not involved a substitution of the centrally planned market as the integrative mechanism for the economy" (Smart, 1998:434) while transformation performed in CEE was based on the assumption that the reduction of state influence over the economy would automatically and quickly stimulate a private sector recovery as long as an appropriate regulatory and incentive framework to support a market economy was put in place (Smart, 1998:429; Angresano, 1994:82). China has, nonetheless, been seen as more successful in achieving an economic transition to capitalism than many other state socialist economies. For example, since 1978 China's real GDP has recorded much higher growth than other state socialist economies, even exceeding other developing Asian economies, comparable to Japan from 1960 to 1974, and South Korea from 1965 to 1978 (Smart, 1998:428). Much of the growth in China has been implemented by a different mode of development than in CEE, for it is based upon export-oriented capitalist industrialisation through the introduction of foreign direct investment (FDI).

The impacts of inward investment on the economy, however, have undergone further regional disparity in China. Nonetheless, only some literature concentrates on the inter-regional dimensions of economic change related to FDI (Fan, 1995, 1997; Leung, 1996), although a vast amount of literature is concerned with assessing the impact of these changes at the national level (for example, see Murphy, 1974; Kleinberg, 1990; Shirk, 1993; Lardy, 1994; Nolan, 1994; Perkins, 1994; Griffin and Khan, 1994; Yusuf, 1994; Chen, Chang and Zhang, 1995; Ma, 1997; Smart, 1998). The paper therefore aims to contribute to the discussion on the relationships between FDI and regional development in China.

The strategy of economic development in China has favoured the eastern region, especially "new industrial spaces," suggesting preferential policies in foreign investment, foreign-exchange retention, revenue-remittance, pricing and finance (Fan, 1995:426). These preferential policies have played a critical role as the institutional mechanism for the introduction of FDI. Along with this, "new industrial spaces" have undergone industrial restructuring dominated by foreign investment. Consequently, it has given rise to the uneven development of transition and regional fragmentation. It is argued that this is a new form of uneven regional development, differentiating development between the *Mao* and the *post-Mao* era. Indeed, in order to understand the regional fragmentation of the contemporary Chinese economy, it is necessary to point out existing regional economic structures and the relationships between central and local government with regard to inward investment. However, such a discussion is beyond the scope of this paper. The paper therefore focuses primarily upon the fragmented pattern of Chinese regional development dominated by FDI.

The paper is divided into three sections. The first section illuminates the process of opening up towards FDI and the geography of regional inequality in contemporary China. It shows that the establishment of new industrial spaces and "preferential policies" for them has led to the dramatic rise of FDI and regional fragmentation. The latter represents the historical contexts of the new forms of uneven regional development. In the Mao era, strategies of regional development were inspired by the ideological concern for regional equality and defence considerations arising from perceived international threats. This mode of development had more or less decreased regional inequality, as state-led investment accelerated big industrial capital investment in the underdeveloped region, especially in the central and the western region. However, regional economic strategies implemented under the Mao era were not able to equalise levels of development. The section focuses on the limit of Mao's development model as the background of FDI introduction. The third section highlights the concentration of FDI in "new industrial spaces" in the eastern region, whose transition is driving the post-Mao era and has led to regional fragmentation. It is analysed by the extent to which FDI has influenced industrial production, international trade and employment.

2 Opening up Towards FDI and the Geography of Regional Inequality in Contemporary China

As a measure of Chinese economic reform, the importance of FDI in China since 1978 cannot be understated. It

	US$ million (% as of world FDI)						
	1984–89	1990	1991	1992	1993	1994	1995
China	2,282 (1.98)	3,487 (1.71)	4,366 (2.77)	11,156 (6.64)	27,515 (13.23)	33,787 (14.97)	37,500 (11.91)
Indonesia	133 (0.12)	162 (0.08)	141 (0.09)	151 (0.09)	273 (0.13)	620 (0.27)	1,750 (0.56)
Malaysia	798 (0.69)	2,333 (1.14)	3,998 (2.53)	5,183 (3.08)	5,006 (2.41)	4,384 (1.94)	5,800 (1.84)
Philippines	326 (0.28)	530 (0.26)	544 (0.34)	228 (0.14)	1,025 (0.49)	1,457 (0.65)	1,500 (0.48)
Thailand	676 (0.59)	2,444 (1.20)	2,014 (1.28)	2,116 (1.26)	1,726 (0.83)	640 (0.28)	2,300 (0.73)
Vietnam	2 (0.00)	16 (0.01)	32 (0.02)	24 (0.01)	25 (0.01)	100 (0.04)	150 (0.05)
Slovakia	–	–	–	–	199 (0.10)	303 (0.13)	250 (0.08)
Czech Rep.	–	–	–	–	563 (0.27)	862 (0.38)	2,500 (0.79)
Former CSFR	43 (0.04)	207 (0.1)	600 (0.38)	1,103 (0.66)	–	–	–
Poland	16 (0.01)	89 (0.04)	291 (0.18)	678 (0.40)	1,715 (0.82)	1,875 (0.83)	2,510 (0.80)
Hungary	–	–	1,462 (0.93)	1,479 (0.88)	2,350 (1.13)	1,144 (0.51)	3,500 (1.11)
World	115,370 (100)	203,812 (100)	157,730 (100)	168,122 (100)	207,937 (100)	225,660 (100)	314,933 (100)

Source: Elaborated from World Bank, 1996

Table 1: Comparative levels of inward FDI in the selected state socialist economies and Southeast Asian economies.

has progressively directed industrial investment policy, leading to the establishment of special economic zones (SEZs) and open coastal cities (OCCs), reshaping attitudes towards work and wealth creation, and helped redesign the business and legal framework. However, it has resulted in further regional inequality. This section illuminates the impact of FDI on the economy and regional inequality in contemporary China.

Given the emphasis on FDI in the process of reforming Chinese economies, it comes as no surprise that China has attracted higher inward investment than other state socialist economies and ASEAN in the post-Mao era (World Bank, 1996). Table 1 shows comparative levels of FDI in the selected state socialist countries and Southeast Asian countries between 1984 and 1995. For example, in 1990, China's share in global FDI was only 1.7 per cent. However, data for 1995 show that US$ 37.5 billion was invested in China, accounting for 11.9 per cent of the total global capital flow. This is a result of the response to the abandonment of Mao's policies against foreign capital and technology. [1]

The significance of FDI can be witnessed in three major benefits for the Chinese economy. The first benefit from FDI is the contribution to gross domestic product (GDP). The share of FDI in China's GDP has increased from 0.9 per cent of GDP in 1984 to 16.1 per cent in 1996 (table 2). Secondly, FDI has taken on one of the most important roles in China's international economic activities through increased access to foreign markets. The contribution of FDI to the growth of China's foreign trade has increased. The share of FDI in total exports, for example, increased sharply from only 1.1 per cent of total exports in 1985 to 20.4 per cent in 1992, and to 40.7 per cent in 1996 (SSB 1995; and see table 8). The third benefit is in the form of the creation of employment. Around 5.4 million Chinese were employed by foreign investment enterprises in 1996 (table 3). Although this is only 2.7 per cent of the urban workforce, the significance of FDI for employment is increasing year by year, accounting for a rise from 0.05 per cent of the urban workforce in 1985 to 0.39 per cent in 1990, and 2.7 per cent in 1996.

Notwithstanding the significance of FDI in the Chinese economy, the geography of regional inequality emerged as the result of the interaction of new institutions and foreign business activities. This regional inequality in contemporary China was enforced by the formal

	GDP	Accumulated FDI (RMB 100 million)*)	Accumulated FDI as % of GDP
1981	–	35.0	–
1984	7,171	64.6	0.90
1985	8,964	113.3	1.26
1986	10,202	177.9	1.74
1987	11,962	264.1	2.20
1988	14,928	382.9	2.56
1989	16,909	510.4	3.02
1990	18,531	677.1	3.65
1991	21,617	918.1	4.24
1992	26,635	1,524.6	5.72
1993	34,515	3,005.7	8.70
1994	45,006	4,431.8	9.84
1995	58,478	7,564.8	12.93
1996	68,593	11,031.9	16.08

*) Converted from US$ into RMB using official current exchange rate taken from SSB

Source: Elaborated from SSB, 1995 to1997 a

Table 2: Growth of FDI and GDP in China, 1984 to 1996.

	Total number of employment (10 thousand)	Urban (A)	Foreign firms (B)	B/A (%)
1985	49,878	12,808	6	0.05
1986	51,282	13,293	13	0.10
1987	52,783	13,783	21	0.16
1988	54,334	14,267	31	0.21
1989	55,329	14,390	47	0.33
1990	63,909	16,616	66	0.39
1991	64,799	16,977	165	0.98
1992	75,554	17,241	221	1.28
1993	66,373	17,589	288	1.64
1994	67,199	18,413	406	2.21
1995	67,947	19,093	513	2.66
1996	68,850	19,815	541	2.73

Source: Elaborated from SSB, 1997a

Table 3: The share of employment by foreign enterprises, 1985 to 1996.

adaptation of the "three economic belts division of labour" for the seventh Five-Year Plan (FYP) between 1986 and 1990. They comprise the eastern, central and western regions, according to the region's comparative advantage and regional division of labour. The eastern region specialises in export-oriented industry and foreign trade; the central region in agriculture and energy development; and the western region in animal husbandry and mineral exploitation (Fan, 1997:623). In order to promote export-led industry and foreign trade in the eastern region, the Chinese government established new industrial spaces to attract foreign investment. The government also provided "preferential policies" for investment, foreign-exchange retention, revenue-remittance, pricing and finance to promote these locations. As inward investment in these locations has boosted economic growth, China has undergone new forms of regional fragmentation.

The introduction of FDI in China was underpinned by the adoption of the *Law of the People's Republic of China on Joint Ventures Using Chinese and Foreign Investment* at the Fifth National People's Congress in July 1979 (Lardy, 1994:63). It was further stimulated by the establishment of SEZs in Shenzhen, Zhuhai and Shantou in Guandong Province, and Xiamen in Fujian Province, which had been established along the southeast coast. These SEZs played important roles as testing grounds for experimental economic and social reforms. The central Committee of the Communist Party (CCP) of China and the State Council extended the concept of SEZs to a further 14 coastal open cities [2] between 1984 and 1986. In 1985, three "development triangles," the Yangtze River Delta, the Pear River Delta in Guangdong province, and the Min Nan region in Fujian, were also opened to foreign investors (Chen, Chang and Zhang, 1995). Complementing the opening up policy, new provisions such as the *Joint Venture Implementing Regulation* in 1983 and the *Patent Law* in 1985 further encouraged FDI, making China even more attractive to investors (Kleinberg, 1991:196). These measures were followed, in 1988, by a CCP decision to set up Hainan Province as the biggest and fifth SEZ, and to extend the open coastal areas into an open coastal belt. More recently, the concept of SEZs has been expanded to include Pudong new zone in Shanghai. In 1992, 13 free trade areas were established in major port cities. Until 1990, SEZs were exclusively coastal. Since then they have gravitated inland to include even autonomous regions.

The expansion of these economic liberalisation zones has closely corresponded to the growth of cumulative inward investment. As table 2 indicates, the initial response of foreign investors to the opening of China was less than enthusiastic. From the opening in 1979 to the establishment of SEZ in 1981, the amount of accumulated investment (RMB 3.5 billion) was only half of the 1984 figure (RMB 6.4 billion). Although during the establishment of the 14 OCCs (1984 to 86) China attracted considerable FDI, real growth in FDI did not happen until after the mid-1980s. This was due to uncertainty about property rights and the fear of a Chinese government policy reversal (Kamath, 1990, 1994). Further setbacks occurred between 1988 and 1991, when foreign investment almost ground to a halt in the wake of the Tiananmen Square episode and years of political uncertainty. However, since then FDI has accelerated dramatically, each year accounting for around twice the growth of the previous one. It is important to note the reasons for the post-1991 growth rate. The increase in FDI seems to be associated with a more laissez faire and positive attitude on the part of the Chinese authorities towards foreign investors. Related to this were moves to extend SEZs into inland regions, the Chinese government simplified the contract approval process and improved the security of property rights for foreign investors (Chen, Chang and Zhang, 1995:693; Kamath, 1994). Thus, the expansion of the concept of SEZs and various legislated investment incentives gave rise to a significant increase in FDI.

The statistics in table 4 bear witness to this. The estimated average national per capita GDP for 1996 was RMB 6,123 (US$ 716). [3] Recently published state data for regional GDP suggests that there are significant regional variations from these national figures. The poorest region – Guizhou Province in the western region for instance – records a per capita GDP of only RMB 2,025 or US$ 245 (33 per cent of national average per capita GDP). In contrast, the wealthiest region, Shanghai municipality, recorded a figure of RMB 20,452 or US$ 2,473 (more than three times the national average). Between these two extremes, most regions in the east have a per capita GDP of over 125 per cent of the national average, while only three provinces in the central region – Jilin, Heilongjiang and Hubei – show figures close to the average per capita GDP and only one province in the west, Xingiang, shows a per capita GDP over 65 per cent of the country wide figure. All regions that record above average per capita GDP have received significant levels of FDI.

This is especially seen in eastern regions where per capita GDP is over 150 per cent of the national average. For example, inward FDI in Beijing, Shanghai, Tianjin, Fujian and Guang-

	FDI per capita	Index	GDP per head	Index
Eastern	**1,207**	**204**	**9,395**	**157**
Beijing	1,233	289	12,833	210
Tianjin	2,271	531	11,629	190
Hebei	128	30	5,325	87
Liaoning	422	99	7,672	125
Shanghai	2,777	650	20,452	334
Jiangsu	733	171	9,837	161
Zhejiang	350	82	9,547	156
Fujian	1,253	293	7,994	131
Shandong	301	71	6,821	111
Guangdong	1,689	395	9,365	153
Guangxi	145	34	4,074	67
Central	**94**	**22**	**4,345**	**74**
Shanxi	44	10	4,199	69
Inner Mongolia	31	7	4,269	70
Jilin	173	40	5,123	84
Heilongjiang	152	36	6,445	105
Anhui	8 3	20	3,854	63
Jiangxi	73	17	3,696	60
Henan	57	13	4,016	66
Hubei	117	27	5,099	83
Hunan	116	27	4,118	67
Western	**27**	**6**	**3,469**	**56**
Sichuan	39	9	3,688	60
Guizhou	9	2	2,025	33
Yunnan	16	4	3,690	60
Xizang	0	0	2,654	43
Shaanxi	92	22	3,317	54
Gansu	36	9	2,895	47
Qinghai	2	0	3,762	61
Ningxia	11	2	3,716	61
Xingjiang	38	9	5,478	89
National average	**467**	**100**	**6,123**	**100**

Source: Elaborated from SSB, 1997a

Table 4: Regional per capita FDI and GDP in China, 1996 (RMB).

dong was 4 to 6 times the national average. By contrast, inward FDI per capita in most central and western regions was less than 10 per cent of the national average.

To sum up, the integration of former industrial space in some eastern regions and the new institutional arrangements for attracting foreign investment has facilitated rapid changes in the eastern region, while weaknesses inherent in areas lacking any significant form of industrial base or policies that lead to economic enhancement have seen the central and western regions fall even further behind the east in development terms, as the gulf between the regions has widened in modern times. The contemporary geography of China, therefore, hints at a high degree of regional fragmentation. However, it needs to be placed within the context of the general tendency towards regional economic convergence during the Mao era. The following section highlights the historical pattern of regional policy for regional convergence.

3 The Strategy of Regional Economic Convergence and Regional Development During the Mao Era

The central government of China played a critical role in regional economic development in the Mao period. The economic programmes of state socialism in China were explicitly oriented towards the eradication of the regional inequalities arising from the earlier concentration of foreign investment in the eastern region. [4] Mao inherited this regional inequality from pre-1949 days. Most of the developed areas were in the east and 70 per cent of the assets and output of Chinese industries originated in large coastal cities in 1949 (Fan, 1995:422). Mao's new communist government saw the closure of foreign investment as a way of dealing with the problem of regional inequality. In keeping with Lenin's view that the export of capital from capitalist countries acted as the central mechanism of imperialism and that international companies were "double" parasites, exploiting the working class in their own nation as well as those of colonial or more backward countries (Hayter and Han, 1998:5 to 6), Mao demanded the elimination of spatial inequality by diverting resources from east coast regions to inland regions in accordance with the notion of a socialist ideological commitment to equality. The strategy of the plan was mainly implemented by state investment in capital construction, based on an ideological concern for spatial equality and geo-political responses to national defence considerations, arising from a perceived international threat. State investment thus became the main strategy used to largely equalise regional economic development during the Mao era. However, this development model did not result in the achievement of regional equality. Therefore, this section explains the historical context of the failure of Mao's development model as the background to the introduction of FDI.

To reveal a general trend of regional transformation, the coefficient of variation (hereafter CV) [5] of per capita regional state investment and per capita regional industrial output is calculated for the period from 1953 to 1996. In the absence of data pre-1949, an overview of regional inequality is given for this period. Fig. 1 represents the pattern of regional inequality between 1953 and 1996. The CV represented in fig. 1 is based on data in current rather than constant prices because time-series of provincial price indices are not available. The provincial analysis is based on State Statistical Bureau (SSB) data and provincial statistical data for 1953 to 1992. Data for Tibet province is omitted because data for the province is poor in both quality and availability. Hainan province is aggregated as it has only been recognised in a separate

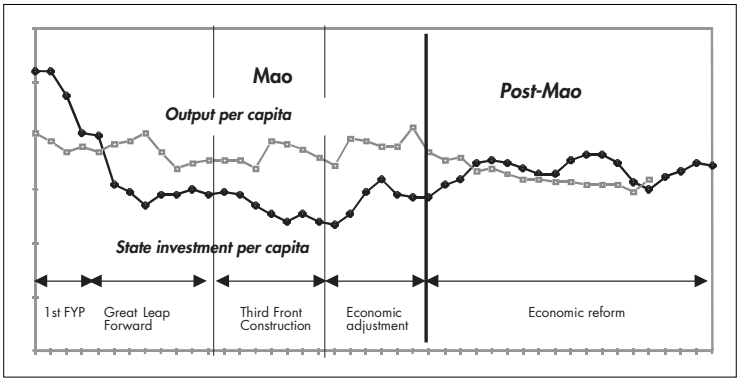


Fig. 1: Regional inequality in China, 1953 to 1996.
Source: Elaborated from Huseh, Qiang and Shucheng, 1993; SSB, 1991 to 1997a

provincial unit since 1988. Therefore, the provincial analysis includes 28 provinces.

Trends in output per capita depend on the relationship between output and population growth. The explanation of variations in the growth of regional industrial output per capita can be differentiated from regional population growth, which depends on natural increases and migration. During the Maoist regime, there was a general decline in state investment inequality, while there was little fluctuation at the level of regional output inequality. Maoist redistributive policies led to paradoxical results, contributing, it seems, to the rise in inequality. This implies the limits of Mao's development model for reducing regional economic unevenness. One of the reasons why was that this measure encouraged relatively rapid population growth in the less developed parts of China.

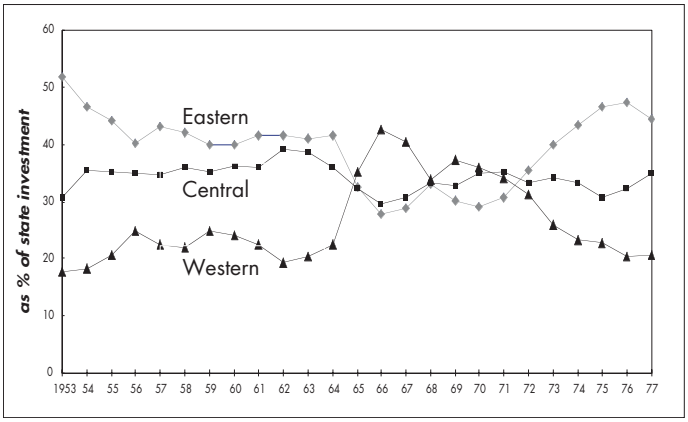
The process of regional transformation can be divided into three periods (fig. 1). The first period, 1953 to 1964, covered the First Five-Year Plan (FYP) and the Great Leap Forward and its aftermath, which successfully reduced the level of regional inequality. The second, 1965 to 1971, was the Third Front period, when there was a concentration of heavy industries input in the inland region. The third period, 1972 to 1977, marked a crisis in the pathway of economic convergence with programmes for economic adjustment.

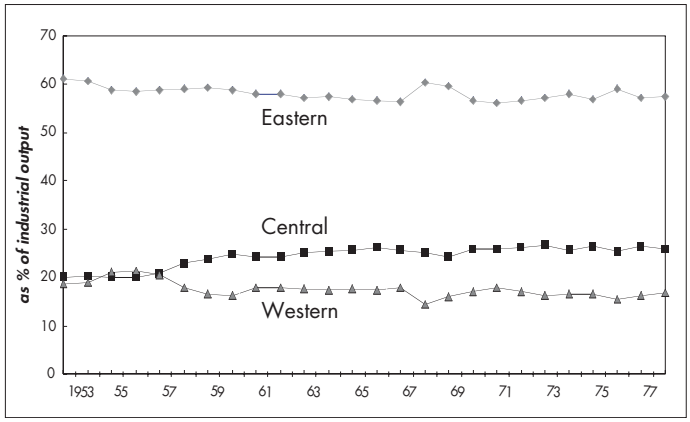
First of all, a strategy aimed at regional equality began as early as the first FYP between 1953 and 1957. During the first FYP, the central government promised to give serious attention to backward inland regions through the provision of state investment. Financial remittances were channelled from more developed regions to less developed inland regions. In order to achieve this, large cities in the less developed regions were permitted to retain most of their revenue and further subsidies were also given (Lardy, 1975). In this way, the allocation of state investment for regional development in the interior region increased significantly from 48.2 per cent in 1953 to 59.7 per cent of total state investment in 1956 (fig. 2a). It contributed to a reduction in regional output inequality. However, the failure of the next development model, the Great Leap Forward, due to famine in the interior between 1959 and 1961, increased it again.

The second major development model was the "Third Front Construction" programme [6] between 1965 and 1971, which was devoted to preparing for war in a geo-political response to a rising international threat. As relations between the United States and the former Soviet Union deteriorated in the early 1960s, and the United States became embraced in the turmoil of the Vietnam war in 1966, China's perception of international threat grew.

In addition, concerns about national security arose from Chinese border clashes with Russia due to the ensuing deployment of a substantial number of Soviet troops in Mongolia in response to the mutual defence treaty signed by both countries in 1966 (Ma and Wei, 1997:220). The threat of war led China to construct three different strategic fronts, which represented a clear defence-oriented strategy. This model advocated the construction of new and large-scale heavy industries, such as iron, steel and military machinery in the third front that were less vulnerable to foreign attack. During this period more than two thousand large and medium-sized industrial, research and educational projects were built, giving rise to 45 new production centres and 30 new industrial cities (Ma and Wei, 1997: 220). As a result, between 1964 and 1970, state investment in the interior increased dramatically from 58.5 of total

Fig. 2a+b: Regional distribution of state investment in capital construction in state-owned enterprises and industrial output in China, 1953 to 1977.
Source: Elaborated from Huseh, Qiang and Shucheng, 1993





Annual average growth rate

	1953–1957		1957–1964		1964–1971	
	Population	RGIO	Population	RGIO	Population	RGIO
Eastern	**3.3**	**11.3**	**2.8**	**6.7**	**1.8**	**10.6**
Beijing	9.3	13.2	9.2	11.6	0.3	10.0
Tianjin	3.4	10.8	2.5	4.4	0.7	10.1
Hebei	2.3	8.8	1.2	5.9	2.1	13.2
Liaoning	4.0	12.3	1.9	5.4	2.0	8.6
Shanghai	2.8	6.5	6.5	7.2	-0.3	7.7
Jiangsu	2.3	8.0	1.1	7.3	2.3	12.8
Zhejiang	2.5	14.5	2.0	9.0	2.4	8.4
Fujian	2.7	11.4	2.3	6.9	2.9	10.2
Shandong	2.2	13.3	0.6	4.3	2.3	13.2
Guangdong	2.5	12.0	1.8	7.6	2.6	8.2
Guangxi	2.1	13.2	1.4	3.7	2.9	14.7
Central	**2.9**	**13.7**	**2.1**	**10.1**	**2.9**	**10.4**
Shanxi	2.7	18.8	2.0	11.2	2.4	9.4
Inner Mongolia	5.3	22.7	4.2	18.5	3.1	4.3
Jilin	2.4	11.2	3.5	9.5	2.6	8.7
Heilongjiang	5.4	8.3	4.7	9.9	3.5	8.9
Anhui	2.1	16.8	–0.7	6.6	3.5	12.0
Jiangxi	2.2	9.9	2.1	8.4	3.0	12.4
Henan	2.2	8.4	0.7	9.5	2.8	14.9
Hubei	2.2	14.5	1.6	8.7	2.7	10.8
Hunan	1.8	13.0	0.7	9.2	2.8	12.4
Western	**3.3**	**13.9**	**1.5**	**5.0**	**3.4**	**10.7**
Sichuan	2.1	16.2	–0.4	4.4	3.1	10.7
Guizhou	2.5	12.5	0.6	5.4	3.6	13.6
Yunnan	2.3	15.5	1.4	5.4	3.1	9.9
Xizang	n.a.	n.a.	n.a.	n.a.	2.0	n.a.
Shaanxi	2.8	10.7	2.2	4.2	2.4	12.0
Gansu	3.3	12.4	0.4	3.9	3.4	10.7
Qinghai	5.6	21.9	0.9	2.8	4.3	11.1
Ningxia	4.3	9.9	2.6	8.6	4.1	13.3
Xingjiang	3.9	12.7	4.1	5.3	4.4	4.5
China	**2.5**	**11.2**	**1.4**	**6.9**	**2.7**	**10.1**

Note: The calculation way of annual average growth rate is as follows $g = \frac{\log(At/Ao)}{t}$

t denotes time

Ao denotes initial year value

At denotes final year value.

Source: Elaborated from Hsueh, Li and Liu, 1993 and SSB, 1990 to1997a

Table 5: Trends in regional gross industrial output and population in China, 1953 to 1996.

state investment to 70.9 per cent (fig. 2a). In particular, it was concentrated in the western region, which accounted for 40.3 per cent of total state investment in 1967.

It represented a pathway towards industrialisation, especially in backward rural economies, which rapidly established a heavy industrial base by way of preparing for the international threat. Notwithstanding the concentration of state investment in the interior, the distribution of regional gross industrial output (RGIO) in the western region remained steady with few fluctuations (fig. 2b). Two factors explain this outcome; (1) the location and (2) the production system of invested industries. The location of construction was based on the premise of geographical isolation: mountains and caves were preferred, since these minimised the effect of possible bombing. This industrialisation in the remote regions resulted in heavy costs and economic inefficiencies. It also led to a lack of agglomeration economies and infrastructure in the production systems as the backward region was lacking technology and human resources. Branches and workshops were located in different regions for the same reason, and each branch unit was complete with its own transportation system, following the Maoist notion of "self-reliance" or "self-sufficiency" (Fan, 195:423).

This discouraged the integration of industrial production into other locations. Because of this, regional output did not increase as fast as state investment in less developed areas. Inequalities in output per head also did not diminish, despite the decline in the gap of state investment inequality.

One of the reasons, however, for the failure to induce greater equality was differentiated population growth in the western and eastern regions. During this period (1964 to 1971), the annual average population growth in the central and western regions was higher than in the eastern region, pulling the growth in output per capita downward while the annual average growth of regional industrial output in the central and western regions was similar to that in the eastern region (table 5). For example, the annual average growth of Beijing, Tianjin and Shanghai in the eastern region was 0.3, 0.7 and –0.3 per cent respectively in 1964 to 1971, while in Qinghai, Ningxia, and Xingiang in the western region it was 4.3, 4.1 and 4.4 per cent respectively (table 5).

Finally, as the international threats disappeared in the early 1970s, China's top leadership promoted a shift of state investment into the eastern region. As fig. 2a indicates, for example, after the abandonment of Three Front Construction, state investment in the eastern region increased significantly from 30.6 per cent of total state investment in 1971 to 44.4 per cent in 1977, whereas in the western region it decreased from 34.2 to 20.6 per cent. It shows that the end of defence-oriented strategies resulted in a crisis on the path to convergence in both state investment and regional output. It is the result of the process of regional economic development implemented by the historical model of development under the Maoist regimes, which created a mis-match between regional economic structure and the production system.

4 Inward Investment and Regional Economic Fragmentation in the Post-Mao Era

A key theme in the last regional policy for economic convergence under Mao's rule was national economic collapse. For example, per capita GDP in 1978 was at a similar level to mid 1950s' levels (Perkins, 1994:23). In addition, the eastern region was still producing some 60 per cent of China's GIO in 1978 (see fig. 3). This continued underdevelopment during the Maoist period led to the new policy of economic and regional development through China's opening-up to the world economy. This development was implemented through the establishment of new regional spaces to attract foreign business enterprises. This transition to capitalism resulted in a new form of regional unevenness during the post-Mao regimes. In this section, the process of regional fragmentation is identified, first by briefly charting the fragmentation of the regional economy, and then by considering the regional implications of FDI on the Chinese economy.

The main point here is that foreign capital has played a critical role in Chinese regional fragmentation along with the establishment of new industrial zones in the eastern region. For example, the level of FDI in 1996 in the western region was only 2.1 per cent of total FDI and the share of the central region amounted to only 9.7 per cent of total FDI, while the eastern region accounted for 88.2 per cent of total FDI (calculated from SSB, 1997:608). The significant growth and concentration of FDI in the eastern region has added to the importance of foreign capital in regional economies. In particular, because FDI has been concentrated in new industrial zones, its impact on the regional economy is significant. This is clearly seen in the contribution of FDI to GDP in Fujian and Guangdong provinces, where new industrial spaces are concentrated (table 6). For example, the contribution of FDI to both regions' GDP was 56.3 and 65.1 per cent respectively in 1996. Also, the establishment of the new Pudong SEZ in Shanghai in 1992, and OCCs, EDTZs, and free trade zones (FTZs) in Jiangsu, Zhejiang and Shandong in the late 1980s accelerated the impact of FDI on regional economic development. Because of this fast growth and great contribution of FDI to regional GDP in a few provinces, as shown in table 6, the low contribution of FDI to regional GDP in the central and western regions has been seen as much less central to the restructuring of their economies. The geographical pattern of FDI in China suggests that the integration of foreign capital activities into the new industrial zones in the eastern region has reinforced regional fragmentation, while the contribution of FDI to regional GDP, especially in central and western regions, has been limited.

Nonetheless, fig. 1 shows that regional inequality in the post-Mao period appears contradictory. Some statistics hint that regional output is converging, despite the fact that regional state investment has diverged. Many commentators have tried to describe this apparent contradiction (Lakshimanan and Hua 1987; Lo 1990; Tusi 1991; Lyons 1991; Wei 1993; Huo 1994; Fan

	FDI as % of GDP						
	1985	1987	1989	1991	1993	1995	1996
Eastern	**0.86**	**2.72**	**4.41**	**7.66**	**14.79**	**26.76**	**30.29**
Beijing	1.01	3.92	9.66	15.03	18.07	30.89	34.53
Tianjin	0.93	4.07	4.43	7.80	13.15	34.12	44.57
Hebei	0.06	0.21	0.46	0.97	2.40	5.20	6.27
Liaoning	0.15	0.92	1.72	4.61	8.12	17.04	19.57
Shanghai	0.68	3.21	6.09	8.60	25.50	35.48	41.25
Jiangsu	0.15	0.64	1.36	2.52	9.73	22.71	22.85
Zhejiang	0.19	0.57	0.89	1.61	4.82	9.48	11.07
Fujian	1.82	3.40	6.65	13.01	29.57	52.47	56.30
Shandong	0.17	0.75	1.32	2.41	7.67	14.92	16.14
Guangdong	3.45	10.37	13.87	24.95	35.02	57.27	65.12
Guangxi	n.a	1.91	2.15	2.73	8.59	14.77	15.57
Central	**0.08**	**0.30**	**0.55**	**0.87**	**4.44**	**5.14**	**5.94**
Shanxi	0.01	0.08	0.23	0.33	1.38	2.02	2.57
Inner Mongolia	0.05	0.32	0.38	0.56	1.39	2.27	2.52
Jilin	0.07	0.48	0.59	1.21	3.66	8.18	9.68
Heilongjiang	0.03	0.37	1.09	1.41	2.50	5.75	6.76
Anhui	0.03	0.37	0.51	0.82	2.23	5.28	6.30
Jiangxi	0.15	0.26	0.53	0.75	3.01	5.56	6.19
Henan	0.05	0.20	0.65	0.98	19.00	3.94	4.37
Hubei	0.06	0.33	0.52	1.02	3.72	7.49	7.91
Hunan	0.23	0.32	0.45	0.74	3.09	5.79	7.12
Western	**0.07**	**0.40**	**0.67**	**0.92**	**1.49**	**3.08**	**3.22**
Sichuan	0.14	0.43	0.56	0.98	2.57	5.67	5.60
Guizhou	0.23	0.49	0.71	1.24	1.83	3.45	3.28
Yunnan	0.03	0.21	0.33	0.40	1.22	2.26	2.19
Xizang	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Shaanxi	0.25	2.00	3.71	4.71	5.95	10.55	11.19
Gansu	0.01	0.05	0.10	0.23	0.37	2.65	3.09
Qinghai	0.00	0.00	0.17	0.19	0.35	0.54	0.53
Ningxia	0.00	0.00	0.02	0.06	0.72	1.19	1.28
Xingjiang	0.00	0.45	0.41	0.46	0.39	1.39	1.81

Note: The figure in the table is the degree of contribution of accumulated FDI on GDP. The amount of accumulated FDI is converted from US$ into RMB using official current exchange rates taken from SSB

Source: Calculated from SSB, 1985 to 1997a

Table 6: Trends in the regional contribution of FDI to GDP in China, 1985 to 1996.

	1979	1981	1983	1985	1987	1989	1993	1995	1996	Trend[1]	Industrial Production %[2]	Employ-ment %[3]
Eastern	**211.0**	**214.0**	**201.9**	**195.4**	**189.4**	**184.6**	**187.9**	**181.9**	**179.0**		**17.9**	**3.0**
Beijing	373.9	375.0	362.9	325.8	299.4	299.4	261.7	186.8	167.8	⇓ C	13.3	1.0
Tianjin	407.6	417.5	396.0	365.6	332.2	323.4	290.9	272.3	287.0	⇓ C	15.1	0.4
Hebei	76.9	69.8	67.4	72.3	76.4	76.2	79.6	76.0	88.7	↑ C	17.4	4.4
Liaoning	198.0	201.9	192.1	193.7	188.4	174.2	167.0	148.9	155.2	↓ C	15.0	1.0
Shandong	74.7	74.9	77.1	81.8	88.4	102.7	132.8	119.0	119.1	C↑ D	19.6	5.0
Shanghai	845.4	825.9	734.5	653.9	585.1	521.6	474.3	443.8	407.1	⇓ C	12.7	-0.5
Jiangsu	112.7	127.8	128.1	151.3	170.4	167.0	195.9	204.7	185.3	⇑ D	23.3	1.8
Zhejiang	71.7	93.8	97.8	125.9	141.2	138.3	179.1	229.3	231.6	C ⇑ D	21.8	2.8
Fujian	49.8	52.7	51.6	58.8	64.4	73.6	94.4	105.9	112.2	C ⇑ D	19.0	5.8
Guangdong	72.7	78.5	79.2	86.8	102.6	119.4	152.4	170.0	172.5	C ⇑ D	22.0	5.7
Guangxi	37.4	36.4	34.7	33.1	35.1	34.3	39.2	44.9	43.1	↑ C	17.8	5.8
Central	**69.1**	**68.4**	**71.0**	**70.0**	**70.5**	**66.9**	**58.4**	**61.4**	**65.0**		**16.8**	**3.2**
Shanxi	84.4	79.0	85.4	83.6	77.0	76.7	69.9	69.8	75.4	↓ D	16.4	2.8
Inner Mongolia	53.0	49.6	54.4	49.9	49.5	50.0	44.8	41.9	46.4	↓ D	16.0	2.7
Jilin	98.5	94.4	100.2	102.8	104.3	96.3	77.8	67.5	67.1	↓ D	14.5	2.2
Heilongjiang	125.0	121.4	122.0	108.9	112.1	100.0	73.6	72.9	72.6	⇓ D	13.4	2.0
Anhui	42.6	42.5	45.0	49.6	50.8	50.1	50.8	64.3	68.0	↑ C	19.6	4.6
Jiangxi	44.2	46.9	45.3	48.3	49.4	48.0	45.4	38.9	37.1	↓ D	16.1	3.1
Henan	46.2	46.7	46.7	48.0	50.8	50.6	52.5	63.5	65.6	↑ C	19.5	5.8
Hubei	74.3	81.3	87.3	87.4	87.7	81.0	67.5	87.0	94.7	↑ C	18.7	1.9
Hunan	54.0	54.0	53.1	51.5	53.6	49.4	43.8	47.0	58.2	–	17.4	4.4
Western	**52.5**	**46.0**	**49.0**	**49.1**	**46.9**	**47.7**	**41.2**	**41.3**	**37.4**		**12.9**	**3.0**
Sichuan	44.6	43.7	45.9	48.1	47.3	46.8	48.9	47.9	41.6	–	16.2	3.9
Guizhou	28.4	24.1	29.2	30.5	27.9	27.7	21.5	19.4	20.2	↓ D	15.1	3.4
Yunnan	34.0	34.6	37.9	36.8	34.9	36.4	34.2	37.0	36.4	–	17.5	2.2
Shaanxi	64.4	58.4	59.1	59.0	56.9	55.6	45.4	41.2	39.9	↓ D	11.3	1.8
Gansu	72.7	59.0	58.6	57.0	51.2	50.1	41.1	41.4	38.6	⇓ D	10.6	4.6
Qinghai	60.1	48.6	50.5	49.9	49.4	53.6	38.7	37.7	32.5	↓ D	8.8	0.9
Ningxia	66.2	48.5	53.2	53.3	51.7	55.7	46.2	47.0	44.0	↓ D	11.6	3.8
Xinjiang	49.3	51.1	57.6	58.3	55.8	56.2	53.7	59.1	45.8	–	12.4	3.3
Average	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**		**17.3**	**3.3**

Note 1: Trend of GIO indices from 1979 to 1996, and of FDI indices from 1985 to 1996

↑ increased by more than 5 – stable trend with little change
↓ decreased by more than 5 C converging to national average
⇑ increased by more than 50 D diverging from the national average
⇓ decreased by more than 50

Note 2: Growth rate of RGIO is based on the period from 1978 to 1996
Note 3: The annual growth rate of the number of regional employed is based on the period from 1985 to 1996

Source: Elaborated from Hsueh, Li and Liu, 1993 and SSB, 198 to 1997a

Table 7: Trends of per capita regional gross industrial output, 1979 to 1996.

1995; Ma and Wei 1997). Fan (1995: 427 to 428) suggested that these contradictory findings are the result of variations in analysis. By using different though overlapping time periods, the effect of scale can produce different results, reflecting real divergence in the trends of the different variables. Fan argued, therefore, that there is a need for a finer scale analysis, perhaps an intra-provincial analysis. Analysis of a specific province with significantly higher or lower growth than other provinces is often more revealing than the analysis of overall inequality. However, although this may provide evidence of clear regional inequality within specific provinces, it does not explain the extent to which regions within specific provinces diverge or converge within the Chinese regional economy. Therefore, it is necessary to carry out analysis at both country and city levels, but it is difficult to reveal regional inequality at the city levels due to the paucity of time serial data. Therefore, this section focuses on the extent to which regions have fragmented as a result of inward FDI in the level of inter-provincial inequality analysis, although there are certain limits to analysing the level of regional fragmentation.

There are four general factors that reduced regional inequality during the post-Mao era despite the concentration of economic development strategies on the eastern region (see fig. 1). First, there was economic development across the whole of the eastern region. Of an estimated average national per capita RGIO for 1979, as can be seen in table 7, there were only six provinces that recorded above average per capita RGIO, while 8 provinces were below half the national average. Two decades later, 9 provinces were above the national average per capita regional RGIO in the eastern region, while 11 provinces were less than half the national average. Secondly, the existing developed industrial region has under-

Employment creation and exports by foreign enterprises, in percent

	Employment				Export				
	1993	1994	1995	1996	1992	1993	1994	1995	1996
Eastern	**3.5**	**4.7**	**5.6**	**5.9**	**17.0**	**24.3**	**25.9**	**27.7**	**38.0**
Beijing	3.6	4.9	5.7	6.2	10.6	12.5	12.8	11.9	19.5
Tianjin	2.9	4.8	6.5	6.7	12.1	24.9	33.5	44.8	63.0
Hebei	1.1	1.5	2.0	2.1	5.8	11.1	14.6	13.1	22.7
Liaoning	1.0	1.7	2.3	2.2	18.8	28.0	31.4	33.4	43.5
Shanghai	4.3	4.8	6.4	7.6	14.6	23.5	26.8	30.6	41.5
Jiangsu	2.1	3.7	3.8	4.2	17.9	27.9	29.7	29.2	42.4
Zhejiang	3.0	3.7	4.2	3.9	12.0	20.1	15.9	13.4	23.4
Fujian	10.0	13.8	14.1	15.6	46.9	51.5	47.2	43.7	53.3
Shandong	1.3	2.0	3.6	3.6	9.0	19.1	24.4	28.1	38.5
Guangdong	8.2	9.2	11.4	11.4	31.6	38.2	37.3	43.6	51.2
Guangxi	1.2	1.4	1.8	1.8	8.0	10.2	10.9	13.3	19.0
Central	**0.6**	**0.9**	**1.0**	**1.1**	**2.7**	**6.2**	**7.2**	**8.1**	**12.8**
Shanxi	0.8	1.1	0.6	0.7	0.7	5.9	7.2	6.4	7.2
Jilin	0.7	1.0	1.2	1.4	1.2	4.4	8.5	17.2	24.1
Heilongjiang	0.4	0.8	1.0	1.0	1.0	2.5	3.9	5.4	8.0
Anhui	0.4	0.7	1.1	1.0	4.4	7.8	7.5	7.3	11.9
Jiangxi	0.6	0.7	0.9	0.8	3.1	7.1	6.6	5.2	7.6
Henan	0.6	1.1	1.5	1.6	3.3	7.7	8.7	7.9	15.5
Hubei	0.7	1.0	1.2	1.2	5.6	10.5	10.3	10.3	20.2
Hunan	0.5	0.5	0.8	0.7	2.2	3.9	5.0	5.0	8.0
Western	**0.3**	**0.5**	**0.6**	**0.7**	**2.1**	**3.8**	**4.3**	**4.8**	**9.0**
Sichuan	0.4	0.3	0.7	0.8	3.0	6.5	0.1	4.5	7.3
Guizhou	0.4	0.7	0.7	0.7	2.7	2.4	7.0	7.1	10.8
Yunnan	0.2	0.4	0.7	0.8	2.6	3.4	2.8	2.9	4.2
Tibet	0.0	0.0	0.0	0.0	0.0	2.0	5.6	2.5	10.5
Shaanxi	0.5	0.4	0.4	0.6	3.7	4.6	5.2	4.0	8.5
Gansu	0.5	0.2	0.7	0.6	1.1	6.1	4.5	5.6	8.6
Qinghai	0.1	0.6	0.3	0.3	0.0	0.0	0.0	5.1	7.3
Ningxia	0.4	2.0	1.6	1.6	0.9	3.8	6.0	5.4	12.3
Xinjiang	0.4	0.2	0.6	0.6	5.1	5.5	7.5	5.8	11.1
China	**1.6**	**2.5**	**2.9**	**2.7**	**20.4**	**31.3**	**28.7**	**31.3**	**40.7**

Source: Calculated from SSB, 1993–1997a, and SSB, 1994b

Table 8: Trends in regional employment and export by foreign investors in China.

gone slow growth. Five of the six developed provinces in 1979 were downwardly converging in per capita RGIO. This trend towards convergence could explain the overall decline in interprovincial inequality. In particular, the rapid downward convergence in the three municipalities, Beijing, Shanghai and Tianjin, which constitute the highest level of wealth in the Chinese economy, could alone produce this trend. Thirdly, there has been rapid economic growth in the underdeveloped eastern region. Four of five underdeveloped provinces – Guangdong, Zhejiang, Shandong, and Fujian – have gone through rapid upward divergence in per capita RGIO. This is closely linked to the concentration of new industrial zones in these regions, accompanying significant industrialisation and substantial growth in employment.

What is more, annual average growth rates of 17.3 per cent in total industrial production and 3.3 per cent in employment occurred between 1978 and 1996, and between 1985 and 1996 respectively (table 7). However, the geographical subtext to this improvement is the inequality of the huge steps China has taken towards development. The annual growth rate of industrial production in Beijing, Tianjin and Shanghai has been lower than the national annual average growth rate, accounting for 13.3, 15.1 and 12.7 per cent respectively (table 7). This is the result of the concentration of investment and industrialisation in the emerging new regional economies, although they have still maintained the highest levels of per capita RGIO over other provinces. The growth in industrial production and employment between 1979 and 1996 was strongest in the open regional economies of the southeastern region (Guangdong, Fujian, Zhejiang and Shandong province). For example, in 1979 per capita RGIO in Fujian and Shandong was only 49.8 and 74.7 per cent of the national average respectively. One and a half decades later, these provinces recorded annual average growth rates of 19.0 and 19.6 per cent respectively in 1978 to 1996, all of which helped to create more employment. Also, Guangdong and Zhejiang underwent rapid growth, experiencing annual average growth rates of 22 and 21.8 per cent in 1978 to 1996. It shows that the greatest degree of industrial change has been witnessed in the new regional industrial zones, especially the relatively prebackward regions of the east, where rapid growth in response to foreign capital investment is now inherent.

Regional fragmentation as a result of attracting FDI can be found in the levels of the regional share of the labour force by foreign enterprises and the global integration of the regional economies through export-led foreign enterprise activities. The regional impact of foreign investment on employment is uneven, although the proportion of employment creation by foreign investors is diminutive, accounting for only 2.7 per cent of urban employment in 1996 (table 8). However, the proportion of employment creation as a result of foreign investment in the open coastal regions, where new industrial spaces are concentrated, is significant. For example, in Guangdong and Fujian, where SEZs are located, it accounted for 11.4 and 15.6 per cent of total urban employment in 1996, whereas employment by foreign firms in the inland regions accounted for less than one per cent.

What is more, foreign investment has not only influenced employment, but also foreign trade at the regional level. The influence of FDI on trade has increased rapidly, mirroring the rapid growth in FDI in the early 1990s. Exports by foreign enterprises have had a significant effect on China's export figures, accounting for 40.7 per cent of total Chinese exports in 1996 (table 8). More specifically in Tianjin, Guang-

dong and Fujian provinces, over 50 per cent of total regional exports could be traced to foreign investment, contrasting sharply with the inland regions, where it accounted for less than 10 per cent. This indicates that the integration of new industrial regions in certain eastern coastal regions into the global economy is dominated by the activities of foreign business enterprise. As a result, the degree of global integration in these regions has increased significantly, accompanying the dramatic growth in regional exports. Exports by foreign enterprise have further helped to develop the regional economies in which they are based by earning foreign currency. Inward investment in China and the provision of platforms for foreign firms has promoted these regional economies. However, unevenness in the allocation of foreign funds in these regions and the polarisation of the activities they generate has led to regional fragmentation and uneven regional economic development.

5. Conclusion

This paper has identified the mode of development in the Mao period between 1953 and 1977 as a background of the opening-up policy, and the nature of the economic development model associated with the introduction of inward investment in the post-Mao period since 1978. In particular, it has emphasised new "regional transformation" from regional equality in the Mao era to regional fragmentation in the post-Mao era. After the Mao era, the reform of the Chinese economy has accelerated mainly through opening up, especially to foreign investment. The historical policies of Mao's economic development neglected the institutional arrangements of the region, regional economic structures and production systems, leading to regional isolation and recession. Therefore, this paper argues that the introduction of FDI was a result of the limits of Mao's economic development model.

During the post-Mao era, the increase in FDI has led to a set of regional pathways which underlie the contemporary fragmentation of the Chinese economy. First, there is a set of new industrial regions in which FDI has been concentrated. These regions created new economic structures and institutional arrangements to attract and co-ordinate foreign enterprises. This led to a higher level of industrialisation and improved export-led growth in these regions. This, in turn, has produced a higher level of employment creation with an increasing dependency on the global economy. Secondly, there is a group of existing developed industrial regions such as Tianjin, Shanghai, Beijing and Liaoning Province, whose economic structure has undergone adjustment, often through inward FDI. Finally, there is a large group of marginalized and increasingly peripheral regional economies in the central and the western region which have experienced underdevelopment, the result of adopting the "three economic belts division of labour" in the seventh FYP, which promotes export-led growth in the eastern region. Consequently, the divergent pathways created by FDI related to its strategies of regional development resulted in regional fragmentation, which is the new form of regional inequality.

Along with changes in regional structure towards regional fragmentation, there is a need to consider different strategies for regional development, for the consideration of spatial planning and the task of sustainable development in China. First of all, regional cross-border production networks (CPNs) [7] should be established on the basis of regional characteristics. The establishment of CPNs in Guangdong, Fujian and Shandong Provinces is a good example. According to the statistics of Chinese foreign economic relations and trade (CFERT) (1998), FDI in Shandong is dominated by Korea, accounting for 27.3 per cent of total inward FDI in Shandong, and in Guangdong is dominated by Hong Kong, accounting for over 54.8 per cent in 1996. In Fujian, although FDI from Hong Kong still dominated, the proportion of Taiwanese FDI increased significantly from 14 per cent in 1992 to 33.3 per cent in 1996. The main reasons why a particular country's FDI is concentrated on these regions are (1) geo-governance based on ethnic network [8] between Guangdong/Fujian and Hong Kong/Taiwan, and (2) neighbouring economies based on geographical proximity between Shandong and Korea (see Lee 2001 for the detail discussion of geo-governance and neighbouring economies in China). Secondly, the technology of foreign investors should be integrated into the regional economy on the basis of a regional industrial competitive advantage. The strategy for regional development through the introduction of FDI in China has not based on the regional competitive advantage industry, but focused on the enrichment of technology and management methods. It has resulted in the isolation of foreign investors from the local economy due to the lack of appropriated suppliers and buyers, and therefore the local economy has faced some limitations in receiving key tacit knowledge and technology from foreign investors (Lee 2001). As a result, the establishment of CPNs based on regional characteristics and technology transfer from FDI aimed at the development of regional competitive advantage industry are critical strategies for sustainable regional economic development in the future of China.

Notes

[1] Mao's bias against foreign capital can be seen in his manifesto in the National People's Congress. He stated that "ours is an independent and sovereign socialist state. We have never allowed, nor will we ever allow, foreign capital to invest in our country. We have never joined capitalist countries in exploring our natural resources: nor will we explore other countries' resources. We never did, nor will we ever, embark on joint ventures with foreign capitalists." (cited from Red Flag, Beijing, March, 1977).

[2] It includes Shanghai municipality, Tianjin municipality, Dailian and Qinhuangdao in Liaoning province; Yantai, Qingdao and

Lianyungang in Sandong Province; Nantong and Ningbo in Jiangsu; Wensu in Zhejiang province; Fuzhou in Fujian province; Guangzhou, Zhangjiang and Beihai in Guangdong Province.

[3] The US $ figure for 1996 assumes an exchange rate of RMB 8.27 = US$ 1.

[4] Foreign investment in China began with the establishment of the British East India Company in Guangzhou in 1715. Subsequent expansion concentrated along east coast regions such as Shanghai, Guangzhou, Fuzhou, Xianmen and Ningbo between the 1840s and 1850s as a result of the Opium Wars, resulted in opening several treaty ports. After that, in the twentieth century, foreign investment in China was geographically biased towards Shanghai and North China (Hayter and Han 1998:4–5). It is initial concentration of foreign investment in treaty ports pre-1900 and the lack of interaction between treaty ports and inland (Murphy, 1974), that is said to be responsible for the early phases of regional inequality. This was further exacerbated between 1900 and 1940 by the emphasis on Shanghai and northeastern China.

[5] To give a coefficient of variation (CV), weighted standard deviation is expressed as percentage of the mean (M). As regional units vary significantly in size, standard deviation is weighted by the region's share in the total population (TP). If Pi denotes the population of the ith region (i = 1,2,3,4…n), Yi denotes its per head output or state investment in the ith region, and denotes the average of per head output or state investment, the population-weighted standard deviation (WSD) is given by the equation (Dunford, 1993):

$$WSD = \sqrt{\frac{\sum_{i=1}^{n}(Yi-\bar{Y})^2 \times Pi}{TP}}$$

Therefore, the coefficient of variation is given by the equation:

$$CV = \frac{WSD}{M}$$

[6] "The first front refers to the coastal and border areas that would be the first to face attacks in a war. The third front included the vast interior region, south of the Great Wall and west of the Beijing-Guangzhou railway. The second front is in between." (Ma and Wei, 1997:220).

[7] The definition of "CPNs" is "described as relationships among firms that organise, across national borders, research and development activities, procurement, distribution and design, manufacturing and support services in a given industry." (Borrus, 1997).

[8] The concept of "geo-governance" is introduced by Sum (1997) in the context of cross-border regional modes of growth as providing a mode of co-ordination mediated by a multi-layered network of social relations. It involves a new spatially specific structure of social co-ordination for a more or less coherent mode of growth. Especially, Sum (1997: 160–164) refers to emerging global tendencies which are significant in the triad growth poles and their various modes of regional growth in four aspects: (1) the financial time-space moment of mode of growth structured by the practices of networks of multinational banks and trans-local organisations; (2) industrial and technological time-space moments shaped by the practice of various global networks of multinational production firms in interaction with regional and more locally based firms; (3) commercial time-space moments influenced by the practices of networks of multinational service firms and their regional counterparts; (4) culture time-space shaped by social practices embedded in intra- and/or cross culture networks. Here, I simply adopted geo-governance as culture time-space moments based on ethnic networks.

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Mee Kam Ng

Sustainable Development in the Rapidly Growing Socialist Market Economy of Shenzhen

Bottom-up Efforts and Top-down Policies

In just 22 years, Shenzhen, China's first Special Economic Zone, has accomplished impressive economic and environmental achievements. Population in the small border town has grown over 13 times, the size of the city expanded 23 times and GDP grew 731 times. Today the four million city has set aside 76 per cent of its land as green lungs and 45 per cent of the built-up areas are planted with trees. The city won numerous environmental awards and became a laureate of this year's UNEP Global 500 Roll of Honour. Determination to build a "garden city", keen competition for foreign direct investment and the Central Government's firm commitment towards sustainable development have shaped Shenzhen's path towards sustainability. Although the City still has a long way to go to attain socio-economic and environmental sustainability, Shenzhen definitely has the potential to become a model for China's evolving local socialist market economies in pursuing sustainable development.

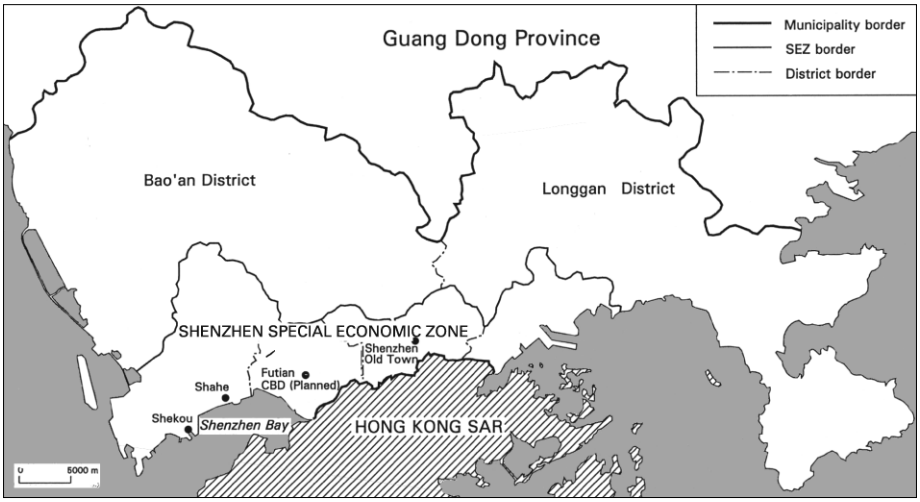

Fig. 1: Shenzhen Special Economic Zone and Longgan and Bao'an Districts.

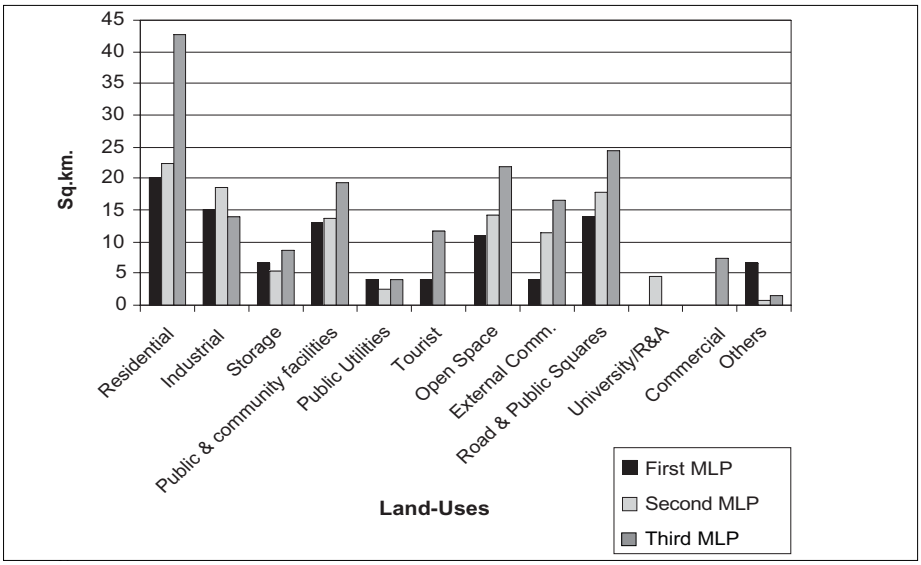

Fig. 2: Land-use distributions in the three Master Layout Plans.
Note: While the planning area of the Third Master Layout Plan includes the whole of Shenzhen, figures here refer to land areas within the original SSEZ for meaningful comparison.

Sources:
1982 First Master Layout Plan: Yeh, 1985, pp. 108 to 130
1986 Second Master Layout Plan: Urban Planning Bureau of the Shenzhen & CAUPD, 1986, p. 14
2000 Third Master Layout Plan: SMG, 1997, p. 35

1 Introduction: Shenzhen – "An Instant City"

Today's Shenzhen is situated within the old Bao'an County. When the Bao'an County was set up in the fourth century, it spanned over today's Shenzhen, Dongguan, Zhongshan, Zhuhai and Hong Kong (Shenzhen Museum, 1999, p. 3). The name "Shenzhen" did not appear in historical documents until the 17th century when the Qing Dynasty government built defence towers in Bao'an and named one of them as Shenzhen (op. cit. 1999, p. 6). In 1911, when the Kowloon Canton Railway was built between Hong Kong and Guangzhou, a small station was set up in Shenzhen. After the setting up of the People's Republic of China in 1949, Shenzhen, similar to the rest of the country, had undergone a collectivisation process and went through the Cultural Revolution from 1966 to 1976. Its proximity to the then British Colony of Hong Kong [1] made Bao'an County the largest source of illegal immigrants to the rapidly urbanising and industrialising capitalist haven since the 1950s.

However, things have changed dramatically since the late 1970s. In 1980, Shenzhen, together with Zhuhai, Shantau, Xiamen, were designated as Special Economic Zones (SEZs). Built upon the old Bao'an County-level city with only 20,000 population in an area of 3 km^2, Shenzhen has been transformed into a city of over 4 million population [2] straddling an area of 2,020 km^2. When it was first established, Shenzhen consisted of a Special Administrative Zone and two districts: Longgan and Bao'an (fig. 1). From 1980 to 1999, an-

Year	Plan and planning parameters	Planning goals and objectives
1982	*First Master Layout Plan:*	Establishment of industrial zones
	Major industrial sector: electronics industry	Establishment of residential areas for workers
	Projected population: about one million by 2000	Infrastructure construction to attract foreign investment
	Projected planning area: 118.6 km^2	Planning: separation of different land-uses
1986	*Second Master Layout Plan:*	Utilise Shenzhen's geographical advantages to the utmost for its development into the 21st century: a long-term comprehensive strategy for land-use and transport planning.
	Projected population: 1.1 million by 2000	Integrated cluster development with green belts in between: for better division of labour and for better quality of life in the linear city
	Projected planning area: 123 km^2	Adopting modern planning standards
	Linear development along major transportation corridor	Flexibility in land-use allocation and infrastructure provision
		Emphasis on balanced and integrated planning especially between development and environmental planning
		Building a city with character
2000	*Third Master Layout Plan:*	A long-term city structure with the Special Economic Zone as the central development axis, accompanied by two other development axes in the east and west. The integrated cluster development in the linear city will continue and be improved.
	Projected population: 4.3 to 5.1 million by 2010	Rapid development had encroached upon a lot of valuable land. Intensified land-uses will be advocated to realise "sustainable development".
	Projected planning area: 2,020 km^2	Building Futian into a financial, commercial, information and tourist hub, facilitating Shenzhen's participation in the global economy
	Projected built-up area: 480 km^2 by 2010 (160 km^2 within the SSEZ)	Providing decent housing for residents
		To provide high standard, modernised urban infrastructure and facilities to facilitate international exchange and interflow
		Creating a pleasant urban environment for leisure living
		Creating the material basis for a modern cultural city

Sources:
1982 First Master Layout Plan: Gu, 1998, p. 89; Lam, 1986
1986 Second Master Layout Plan: Urban Planning Bureau of the Shenzhen Municipal Government & CAUPD, 1986, pp. 4 to 5
2000 Third Master Layout Plan: SMG, 1997, pp. 20 to 23

Table 1: Planning goals and objectives in the Master Layout Plans.

nual population and GDP growth rates were 13.6 per cent and 31.2 per cent respectively (SSIB, 2000a, p. 46). The annual industrial growth rate was 45.4 per cent (op. cit. 2000a, p. 46). In June 2000, Shenzhen won the Global 500 Roll of Honour award given by the United Nations Environmental Programme (UNEP) for "its impressive achievement of marrying rapid and astonishing economic growth with environmental protection" (Mitchell, 2002). However, it was also reported that half of Shenzhen's sea area is polluted (Li, 2002a) and only 54 per cent of urban sewage is treated (SSIB, 2000b, p. 316). How can these two sides of Shenzhen be reconciled? This paper aims at understanding how the Shenzhen government has managed rapid economic growth with concomitant environmental protection and sustainable development.

Section 2 below reviews the history of environmental planning in Shenzhen's development. Planning has been instrumental in building Shenzhen, a laboratory for socialist China to carry out economic reforms and to attract foreign investment. Impressed by Singapore's environment, Shenzhen's early plans had emphasised the need to build a "garden city". One can observe that before 1996, Shenzhen had focused basically on environmental protection. However, after the publication of China's Agenda 21 in 1994 and the announcement of sustainable development as one of China's national development strategies in the Ninth National Five-Year Plan (1996 to 2000), the rhetoric of sustainable development began to appear in Shenzhen's urban land-use plans and local socio-economic five-year plans. Plausible reasons for the changes in rhetoric are discussed. Section 4 examines existing sustainability issues in the city, followed by a conclusion in section 5.

2 Environmental Planning in Shenzhen's Development

Unlike other outward processing zones in developing countries where environmental protection was neglected, the Shenzhen Special Economic Zones (SSEZ) has since its inception paid close attention to environmental issues. Shortly after the establishment of the SEZ, an Environmental Protection Office (EPO) was set up and there had been repeated calls to develop Shenzhen into a "garden city" (Lam, 1986, p. 149). Shenzhen has altogether produced three master layout plans. The draft of the first plan was produced in 1980 and finalised in 1982. The second master layout plan was produced in 1986 and modified in 1989. Before the approval of the third master layout plan in 2000, a draft plan was published in 1996. As reflected in the contents of the master

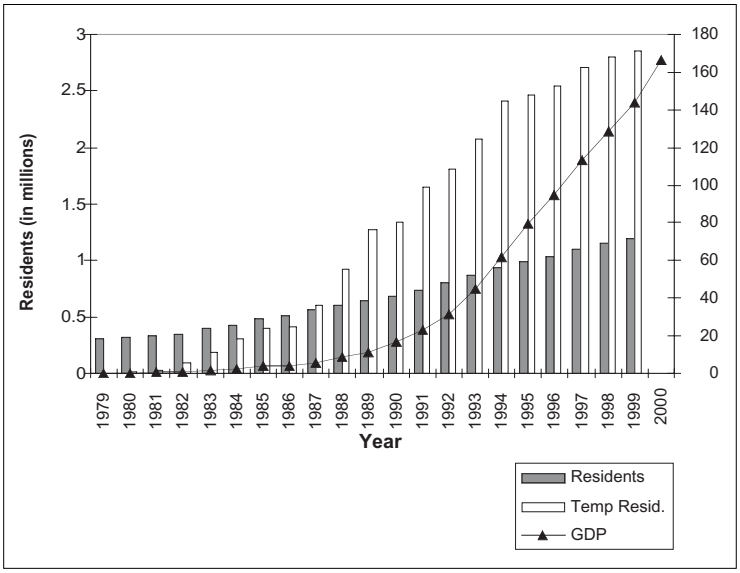

Fig. 3: Population growth and gross domestic product in Shenzhen (1979 to 2000).
Source: SSIB, 1999, p. 96 and 2001, p. 90

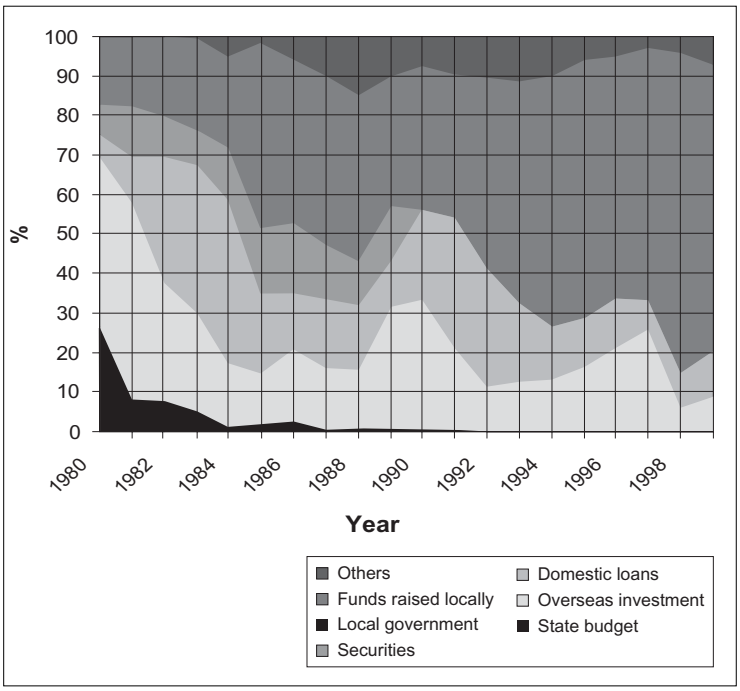

Fig. 4: Financial appropriation of capital construction investment in Shenzhen (1980 to 1999).
Source: SSIB, 2000, p. 192

layout plans made in the past two decades, Shenzhen has been learning the art of building a "garden city" (table 1). This point can also be illustrated by the changes made in the land-use distributions of the three master layout plans (fig. 2).

When the SSEZ was first set up, the purpose was to build an industrial zone for foreign investment and to provide local employment. However, since 1986, as reflected in the Second Master Layout Plan, Shenzhen had formulated a vision for its development into the 21st century. The linear city was planned to develop into integrated clusters with green belts in between. It would pay equal attention to economic and life spaces (Friedmann, 1988). After the incorporation of the Longgan and Bao'an Districts into the SSEZ in 1993, Shenzhen began to plan the whole city into a world class city of the 21st century. In general, the first two master layout plans which coincided with Shenzhen's 7th and 8th Five-Year Plans were concerned basically with environmental protection. However, since the 1990s, especially in the 1996 draft master layout plan and the 9th and 10th Five-Year Plans, sustainable development has become the standard term used as part of the city's development strategy.

2.1 1980s to 1995: Environmental Protection amidst Rapid Urbanisation and Industrialisation

In the First Master Layout Plan, major emission sources were allocated far away from the SSEZ and within the SSEZ, there were segregation of residential and industrial land-uses, and the zoning of twelve per cent of the land as green belts (Lam, 1986, p.150). Environmental impact assessment then was in place to vet major development projects such as the nuclear power plant at Daya Bay (op. cit., 1986, p.151). It was also reported that the EPO imposed stringent control on polluting industries and had been proactive in developing a comprehensive programme of sewage treatment (op. cit., 1986, p.151).

In 1983, after a visit to Singapore, the Municipal Government decided to setback the redline for 30 metres to leave space for greenbelts (Shenzhen Museum, 1998, p.54). While the decision disrupted a lot of ongoing projects, it helped expand major parks in Shenzhen (op. cit., 1998, p.54). In the same year, the Fairy Lake Botanic Garden was set up as a theme park, a showcase of Shenzhen's biological diversity featuring many rare and endangered plant species (Shenzhen Daily, 2002). In 1986, when the Second Master Layout Plan was published, the government called for environmental protection at various fronts. The plan set various rules to ensure good water quality in reservoirs. Pollution problems in Shenzhen and Buji Rivers were discussed and measures were proposed to enhance river and marine water quality (Planning Bureau, 1986, p.24). Noise pollution generated from traffic and construction rather than industrial sources was a concern. And the plan also stressed the importance of environmental monitoring.

Fig. 3 shows the rapid growth of the economy and the population. While foreign direct investment made up 30 to 50 per cent of Shenzhen's capital construction investment in its first few years of development, the capital went largely

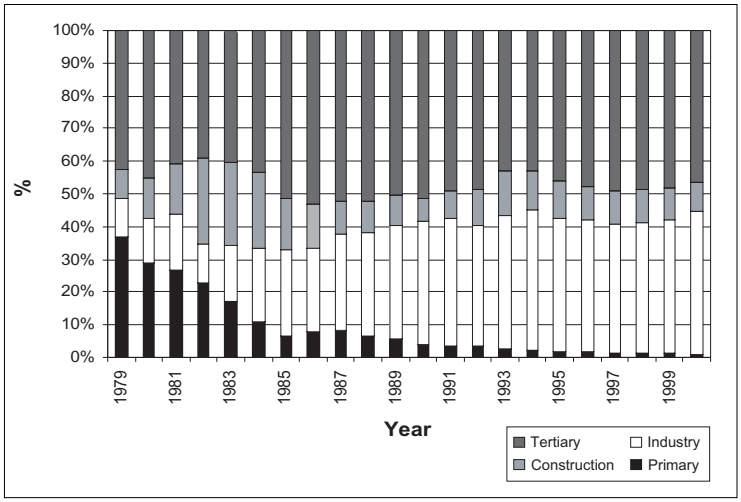

Fig. 5: Composition of gross domestic product in Shenzhen (1979 to 2000).
Source: SSIB, 2001, p. 91

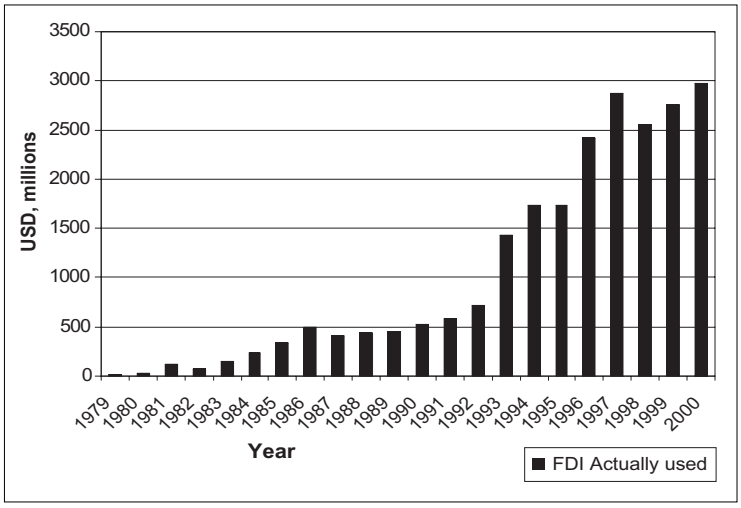

Fig. 6: Foreign direct investment actually used in Shenzhen (1979 to 2000).
Source: SSIB, 2002, p. 243

into real estate development and the amount dropped steadily afterwards (fig. 4) (Wong, 1985; Chiu, 1986). In 1985, only three out of the ten planned industrial estates were ready for development (Wong, 1985) and most of the investments were from bureaux and departments from the Central Government. Nevertheless, in the ten years between 1986 and 1995 Shenzhen rapidly evolved into an industrial city. The contribution of industries to GDP was only about 26 per cent in 1986. In 1995, it jumped to over 40 per cent (fig. 5). It was reported that at 1994, 677 major industries released 33 thousand million m^3 of waste gases, including 1,911 tons of dust and 473 tons of industrial powder and particles (EPO, 1995). The EPO also reported serious pollution of the Shenzhen and Buji Rivers (op. cit., 1995). The waste water treatment rate in the urban areas was only 10.3 per cent though the industrial waste water treatment rate was 98.1 per cent. Marine water and noise pollutions were rather serious. While solid wastes were treated within the SSEZ, situations outside it were beyond control, causing serious pollution to surface running water (op. cit., 1995). While Shenzhen had 43.9 per cent of its areas zoned as green belt and was awarded China's Garden City and an Advanced Green City in 1994, illegal constructions were found within the green buffers every now and then (op. cit., 1995).

It should be noted that when the 7th (1986 to 1990) and the 8th (1991 to 1995) Five-Year Plans were announced, Shenzhen's socialist market reforms were still confined to simplifying government structures and decentralising power to economic enterprises run by government units (Shenzhen Museum, chapter 4). Although foreign investment had increased over the years, the economy of Shenzhen was still basically operated within a "planned economy". It was not until 1994 that the linkages between economic activities and the government's executive functions were severed (Shenzhen Museum, 1998, p. 276), giving rise to a "socialist market economy". The delinking of economic enterprises from the government, together with the introduction of the land and housing markets in the late 1980s had restructured the financial appropriation of capital investment in Shenzhen and boosted foreign investments (Fig. 4 and 6). The increase of "market elements" had rendered urban growth and planning less controllable.

2.2 1996 to ...: Sustainable Development and the Building of a World-Class City

By 1996, Shenzhen was a very different place when compared to 1985 when the first industrial district was ready for occupation. Between 1985 and 1996, the population had grown from 0.81 million to 3.52 million (+435%); gross output value of industry had increased from 2.5 billion yuan to 143 billion yuan (+579%); fixed asset investment grew almost ten times from 3.3 billion yuan to 33.8 billion yuan and local financial revenue and expenditure in budget increased from 0.63 billion yuan to 13.2 billion yuan (+2,095%) (SSIB, 2000, pp. 97, 120, 182, 234). However, throughout these years, there was increasing competition by the equally rapidly growing Pearl River Delta region and other opening regions in China. To maintain the momentum of growth and appeal to further foreign investment, the Shenzhen Government made a bold decision in 1993 to extend the boundary of the Shenzhen Special Economic Zone to embrace the Longgan and Bao'an Districts. The move showed the government's determination to rationalise land-use and development in the city to build Shenzhen into a world class city.

The Third Master Layout Plan, which was produced in 1996 but was not approved by the Central Government until 2000, mapped out a strategy to develop Shenzhen into a modernised eco-

nomic zone and a world city with a prosperous economy, a stable and safe society, an amiable environment and a rational spatial layout with comprehensive provision of infrastructure. Shenzhen is to be developed into a city with the "environment of Singapore and efficiency of Hong Kong" (SMG, 2000, pp.1 to 2). The city aims to become a regional centre for finance, information, trade, commerce, transportation and tourism as well as high-tech development and R&D centre in southern China. Shenzhen will develop a modernised economic structure led by high-tech and other advanced industries, supported by modern service sectors such as logistics, finance, information, trade and commerce, and a well-developed urban agricultural sector. Socially, the city will control population size, improve the quality of human resources, utilize technology and education to enhance development and nurture modern urban culture. Environmentally, pollution and soil erosion will be controlled; new land development will be limited and natural reserves and heritage will be protected. The plan aims to turn Shenzhen into a model city environmentally and ecologically in the Pearl River Delta and China. At the regional level, Shenzhen will coordinate with Hong Kong its land-use and transportation planning and development (Ng and Tang, 2002, p. 26).

Since 2000, the Shenzhen Municipal Government has committed itself to build the City with "bluer sky, cleaner water, greener fields, more flowers, prettier city, nicer breezes, fresher air and longer lives" (Shenzhen Commercial News, 2000a). In 2001, the Shenzhen Municipal Government announced "measures to implement the sustainable development strategy to enhance the building and conserving of Shenzhen's ecological environment". Indicators were set up to monitor the process (Shenzhen Commercial News, 2000b). The main measures taken by Shenzhen in preserving and constructing an ecologically friendly environment are: to develop the right industrial mix to lessen pressure on the environment; to control population growth within the carrying capacity of the environment; to "conserve in development and to develop in conservation"; to develop clean and convenient renewable resources; and to invest about 20 billion to raise comprehensively the city's environmental quality (Shenzhen Commercial News, 2000b, Shenzhen Daily, 2002).

In the past decade, the Shenzhen Government has passed 38 environmental protection laws and rejected 3,619 proposed investments on environmental grounds (1,000 in 2001) (Li, 2002a; Mitchell, 2002). In 1997, the City had a major facelift in terms of cityscape and won the country's award for a Model City on Environmental Protection (Shenzhen Commercial News, 2001a). Shenzhen has 170 km^2 of natural reserve and a mangrove of 368 ha (Shenzhen Daily, 2002a). In the urbanised areas, 45 per cent of land in the built up areas is planted with trees and Shenzhen has set aside 76 per cent of its land as green lungs (Xinhua News Agency, 2002). Per capita green belt is boosted to 14 m, and there are 37 parks covering 3,175 ha (Xinhua News Agency, 2002a). Air quality is fine for 99 per cent of the year and 98 per cent of the drinking water is up to standard (Hong Kong Commercial News, 2002). More than 42 billion yuan has been used on providing infrastructure and raising public awareness for environmental protection (Shenzhen Daily, 2002b). The effectiveness of environmental education can be reflected in the incident of protecting the Futian National Reserve.

In 1994, after learning that a coastal Binhai (literally means "coastal") Thoroughfare would be built along the Futian mangrove, many local people objected to the idea. In response, the Municipal People's Congress committee appealed to the government to protect the mangrove. In November 2002, the Municipal Government enacted a new law, which forced planners to move the central point of the road 200 metres northward to avoid the main part of the mangrove (Shenzhen Daily, 2002c). In 1997, the government drafted a new overall design for the preserved area that included a museum and environmentally friendly office buildings which are now under construction (op. cit., 2002c).

The efforts of Shenzhen in sustainable development have been widely recognised. In December 2000, it was honoured as the top "World Garden City" (Shenzhen Commercial News, 2001a). In 2001, Shenzhen became the champion among 10 cities recognised by the Central Government for their efforts in protecting and cleaning the environment (op. cit., 2001). In June 2002, it hosted the Global 500 Environment Forum during the World Environment Day celebrations and was awarded the UNEP's Global 500 Roll of Honour for environmental achievement.

2.3 Reasons for Shenzhen's Quest for Sustainable Development

Bottom-up efforts and top-down policies account for Shenzhen's quest for sustainability. Since its inception, decision makers have determined to build Shenzhen into a "garden city". Environmental awareness has been strong in the industrialisation process. This awareness was still very much alive when the early mode of low-value added, outward processing production was challenged in the late 1980s when China opened up many more open economic zones throughout the country. As a result, Shenzhen has rapidly lost its advantage as a cheap production site. Faced with increasing competition and the restructuring of the economy, the Municipal Government believed that an improved environment will help lure more foreign investment into upstream high technology businesses.

In fact, ever since the 1990s, Shenzhen has increasingly relied on foreign investment (fig. 6). The actual foreign capital used by Shenzhen from 1980 to 2000 had exceeded US$20 billion, two-thirds of which was used after 1995 (Li, 2000, p.15). Foreign investors from 67 countries and regions around the world, including 76 on Fortune magazine's Top 500 List, had set up more than 14,000 foreign-funded enterprises in Shenzhen (op. cit., 2000, p.15). The value of high-tech products was 106.45 billion yuan in 2000, an increase of

Sustainability Issues	Shenzhen
Ecologically ethical utilisation of natural resources	
Carrying capacity of nature	Shortage of water resources: 550 m^3/person (only of national average and 1/5 of provincial average). Only 20% of water resources in Shenzhen can be used[1]
	Air pollution: There are 500,000 cars[2]. Increase in the number of new automobiles: 300/day
	Inadequate sewage treatment facilities: only 50% of urban sewage is treated[3]
	Rapid industrialisation and urbanisation have worsened water pollution problems
	Illegal construction leading to soil erosion and water pollution[4]
	More than half of its sea area was polluted[5]
Biodiversity	Insecticides killed insects and disrupted the food chain, which accounts for the small number of native birds in Shenzhen[6]
Three "R"s to minimise wastes and energy consumption	Discussed in measures to implement the sustainable development strategy to enhance the building and conserving of Shenzhen's ecological environment announced in 2001
Intra- and Inter-generational equity	
Demographic stabilisation	Rapid population growth due to immigration. Young population and high labour participation rate. Population grew from 0.3 million in 1979 to 4 million in 2000.[7] Unofficial figure is 7million.[8]
	Majority (over 70%) are temporary population
Reforming market economy: restorative	Developing an outward-looking export-oriented economy. Modelled on elements of the market economy.
Diversity in human resources development	Talented population coming from the rest of the country.
Diversity in built environment	Most of the infrastructure projects in Longgan and Bao'an are privately and inadequately funded[8]
	5.2 million m^2 of illegal construction was cleared in 1999 and 2000, which added up to 5.9 million m^2 of land[9]
Diversity in economic activities	Industrial value added made up 41 per cent of GDP[10]
	Contribution of science and technology to development: 51%[10]
	Expenditure on research and development as a percentage of GDP: 2.57%

Note: The sustainable development framework is adapted from Ng, 2002, p. 31.

[1] Renmin Zhengxie Bao (2001), Shenzhen's population and sustainable development, 25th December 2001 (in Chinese).

[2] Shenzhen Commercial News (2001), Should Shenzhen control private cars? 30th March 2001 (in Chinese).

[3] Chiu, C.T. and Tse, Y. (2001), Let the world know about Shenzhen, Hong Kong Commercial News, 23rd November 2001 (in Chinese).

[4] Tse, W. (2001), Population and the environment are Shenzhen's major sustainable development issues, Shenzhen Commercial News, 27th March 2001 (in Chinese).

[5] The finding was reported in an ocean environmental-quality report released by the Shenzhen Municipal Government in May 2002, according to Li, C. (2002), UN green award for polluted Shenzhen, South China Morning Post, 17th May 2002.

[6] Tse, W. (2001), Population and the environment are Shenzhen's major sustainable development issues, Shenzhen Commercial News, 27th March 2001 (in Chinese).

[7] Ng, M.K. (2002), Sustainable urban development issues in Chinese transitional cities: Hong Kong and Shenzhen, International Planning Studies, Vol. 7, No. 1, pp. 7 to 36.

[8] South China Morning Post, Shenzhen puts on clean face as city grows to new horizons, 7th May 2002.

[9] Shenzhen Commercial News (2001), Will to remove illegal construction, 27th March 2001 (in Chinese).

[10] Shenzhen Commercial News (2001), How modernised is Shenzhen? 29th March 2001 (in Chinese).

Table 2: Sustainable development framework and Shenzhen's performance.

29.8 per cent when compared to the previous year (Shenzhen Commercial News, 2001b). High-tech industries occupy 42.3 per cent of the gross output value of industries with sales revenues over five million yuan (op. cit., 2001b).

The ambitious plan to provide a nice environment to attract more foreign investment was given a strong boost by the national development policies adopt in the Ninth Five-Year Plan (1996 to 2000). Recognising the huge environmental costs that have been incurred since the adoption of the open door policy, the Chinese Central Government is determined to place equal emphasis on development and environment (Ng, Chan and Hills, forthcoming). Two years after the first Earth Summit, China's Agenda 21 was approved by the State Council of the People's Republic of China on 25th March 1994. The programmes in China's Agenda 21 have since become the strategic guidelines for the formulation of medium and long-term socio-economic development plans at national and local levels. At the central level, China's Agenda 21 was used to guide the formulation and finalization of the Ninth Five-Year Plan and the Long-Term Objectives for the Year 2010. As all lower level governments had to plan within the framework of these two documents, local governments started to adopt the sustainable development discourse in their respective five year and long term socio-economic plans.

In fact, as early as July 1994, the State Council had issued a notice to all provinces, autonomous regions and municipalities encouraging them to implement China's Agenda 21 (ACCA21, 1996, p.3). In February 1995, the State Planning Commission and State Science and Technology Commission which are the leading agencies in formulating and implementing China's sustainable development strategy, issued a directive requesting local and sectoral governments to develop a better understanding of the overall strategy of China's Agenda 21 in order to better integrate the principles of sustainable development into their Ninth Five-Year Plans and Long-Term Targets for the year 2010 (op. cit., 1996, p.3). Capitalising

Sustainability Issues	Shenzhen
Diversity in culture	Community cultures are encouraged. In Futian alone, 327 civic communities are set up to promote cultural acitivites[11]
Basic needs	It was reported that migrant workers' shacks were demolished along the Pingnan Railway before the World Environment Day was held in June 2002[12]
	Over half of the population still lack accommodation[13]
	Inadequate public sports facilities: 0.48 m^2/person[14]
Social cohesion	Shenzhen is a dual society: temporary labourers/migrants vs talented elite[15]
	GINI coefficient: 30%[16]
Equity in governance	Emerging discussion as can be seen in various newspaper reports
Equal opportunities	No discussion in the planning circle yet
Geographical equity: self-reliance	The agriculture sector is discussed in the Tenth Five Year Plan but its importance in terms of contribution to GDP has been declining
Responses	
Long-term view with system thinking, feedback loops and strategic information	Contemplating administrative reforms[17]
Horizontal cross-sectoral approach	No information available
Vertical integration	No information available
Politics: new governance (three-way partnership)	No information available
Sustainable planning process: participation and dialogue	No information available. The planning process does allows a participation and comments; and the political process allows a certain degree of dialogue between the mayor, people's representatives and local residents
Law and legislation on environment management	Developing with more "teeth"
Market: green consumption, ecological modernisation	Banning the use of foam lunch boxes in 2001 as a response to Central Government's decision to stop manufacturing, selling and using foam eating utensils.
Socio-cultural changes (public awareness)	Slowly rising environmental awareness.
Financing	No information available. However, the Municipal Government will invest 20 billion yuan in environmental protection from 2002 to 2007.[18]

Note: The sustainable development framework is adapted from Ng, 2002, p. 31.

[11] Yu, M. (2001), Community culture, Shenzhen Commercial News, 30th October 2001.

[12] Li, C. (2002), Shenzhen campaigns to be seen as "green", South China Moning Post, 2nd June 2002.

[13] Li, G. and Wang, C. (1998), Directing spatial development in an international city, in Collection of Publications by Staff Members, Urban Planning and Design Institute of Shenzhen 1990 to 1998, pp. 40–47, Shenzhen, UPDIS (in Chinese).

[14] Shenzhen Evening News (2001), Let Shenzhenese be stronger and live longer, 28th March 2001 (in Chinese).

[15] Ng, M.K. (2002), Sustainable urban development issues in Chinese transitional cities: Hong Kong and Shenzhen, International Planning Studies, Vol. 7, No. 1, pp. 7 to 36.

[16] Shenzhen Commercial News (2001), How modernized is Shenzhen? 29th March 2001 (in Chinese).

[17] Mitchell, T. (2002), Shenzhen test-runs government reforms, South China Morning Post, 20th July 2002.

[18] Mitchell, T. (2002), $19 billion [HK$] green plan for Shenzhen, South China Morning Post, 5th June 2002.

Table 2 (Continuation)

on the national turn towards sustainable development, environmentally conscious Shenzhen seized the opportunity to switch its rhetoric and jumped on the sustainability bandwagon. While the change started in the Ninth Five-Year Plan, it was in the Tenth Five-Year Plan that the sustainability discourse firmly established in government circles. While Shenzhen's environmental achievements are as impressive as its economic ones, can Shenzhen pass the sustainability test?

3 Is Shenzhen Sustainable?

Sustainable development is more than just environmental protection. Fundamental to the concept are two inter-related components: human beings and the natural environment (Ng, 2002, p. 8). Demographic stability in terms of fertility rates, migration patterns and ethnic compositions, and a respect for the ecosystem are essential to maintain sustainability (op. cit., 2002, p. 8). The respect for ecology goes beyond an ethical utilisation of natural resources, and demands intra- and inter-generational equity (World Commission on Environment and Development, 1987; United Nations, 1992 quoted in Ng, 2002, p. 8). "Intra- and inter-generational equity cannot be achieved without long-term economic prosperity and a diversified and pluralistic society championing social and geographical equity… In other words, a city's wealth should not be measured in economic terms alone. Social and environmental capital is also important. To nourish different types of capital, social equity, equity in governance and opportunities are essential" (Ng, 2002, p. 8). Table 2 outlines Ng's synthesis of a sustainable development framework and the evaluation of Shenzhen's performance against the various aspects.

The results suggest that Shenzhen as a rapidly growing industrial economy facing constant demographic pressure is confronting a lot of sustainable development challenges. The rapidly growing population is a major challenge to Shenzhen's sustainability. There are many environmental problems, from water short-

age to air and water pollution. For the social dimension, removing illegal constructions in an increasingly open economy and society constantly tests the government's skills in handling social conflicts. There have been cases where police and officials had faced violent resistance from villagers trying to save their illegal property from demolition (Li, 2002b). Unless the government manages to provide affordable housing by market or other means, illegal construction problems will probably continue for some time. According to Li (2002b), a government official estimated that "about 500,000 privately constructed apartment buildings in Shenzhen accommodate 2.5 million people, accounting for one-third of the population".

With the unfolding of the socialist market economy and increasing reliance on market means to solve various socio-economic issues, satisfying basic needs and enhancing social cohesion will prove to be more difficult than maintaining certain levels of environmental standards. Shenzhen cannot claim to be a sustainable city until she finds a satisfactory way to integrate the community's socio-economic and environmental concerns in the development process.

4 Sustainable Development with Chinese Characteristics?

In less than a quarter of a century, Shenzhen has not only transformed from a rural border town into a major industrial metropolis, she has also become an internationally recognised "garden city" with appealing cityscape and urban design. Yet, if tested against the basic and derived sustainability criteria, Shenzhen may still have a long way to go towards sustainability. Nevertheless, as remarked by Professor Niu, principal scientist responsible for the 2002 Report on China's Sustainable Development Strategy (SDRG, 2002), Shenzhen probably would be the first city in the Mainland China to realise modernisation [3] (Zhang, 2001). Shenzhen has been learning how to maintain a satisfactory environment in the course of rapid economic growth. Given the city government's outstanding track record of inventing and re-inventing hard and soft infrastructure to cope with changing socio-economic and environmental demands, and the Chinese Central Government's progressing commitment to sustainable development, Shenzhen should be able to move beyond environmental protection to achieve sustainability. In this sense, Shenzhen's quest for sustainable development may serve as a model for local socialist market economies along China's coastal region where the social fabric and environmental resources have been constantly challenged by the forces of globalisation.

Notes

[1] Geographically, Hong Kong was south of Shenzhen. Hong Kong was a British Colony from 1842 to 1997.

[2] While the official population figure in 1999 was 4.05 million with 70 per cent as temporary residents (SSIB, 2000, p.96), it was reported that the population could be 7 million (SCMP, 2002).

[3] In the Mainland, modernisation is often used inter-changeably with sustainable development. See China's Agenda 21 at http://www.acca21.edu.cn/ca21pa.htm1.

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AGS Future Cities: Guangzhou – A Partnership for Sustainable Urban Development

In the context of the "Alliance for Global Sustainability" (AGS) – a research partnership between ETH Zurich, MIT in Boston and the University of Tokyo – a cooperative project with the city of Guangzhou in South China was established in the year 2000. Its goal is to support the city of Guangzhou in addressing problems of sustainable development related to transportation, housing, and water and land-use management. Following an initial phase of exploring mutual interests between research teams and Guangzhou municipal policy makers, three subprojects were identified: (i) urban transportation systems and policies, (ii) water resource management, and (iii) improvement of the residential environment of Zhu Village as a model for urban renewal. The article describes the rapidly changing planning context and highlights progress and findings from the three subprojects.

As longstanding partnerships sometimes have their roots in coincidental meetings, so too did this project take shape. Two of the authors visiting Guangzhou had the chance to meet the then Deputy Director of the Urban Greening Department of Guangzhou. The informal discussion in an exquisite restaurant, overlooking a beautifully landscaped lake park in the heart of Guangzhou, quickly centered on the challenges to sustainable development posed by the rapid growth of Guangzhou and the surrounding region of the Pearl River Delta. This meeting of minds was subsequently turned into an opportunity to apply and adapt some of the technical, social and policy analysis tools and methodologies developed in conjunction with an earlier AGS project "Future Cities: Toward Sustainable Cities" [1] to the real world challenges of a thriving megacity.

1 Project History

In 1999, a proposal was submitted to the Alliance for Global Sustainability to provide initial two-year funding for establishing a partnership with the Municipal Government of Guangzhou. In this partnership, the three research teams from MIT, ETH Zurich, and University of Tokyo, would each contribute their particular expertise on issues of sustainable development of interest to the city government of Guangzhou. Fortunately, the teams were joined by Prof. Jia Beisi from the architecture department of the University of Hong Kong, a former postdoctoral student at ETH Zurich, who had been key in establishing initial contacts and continues to play a central role as "cultural translator". After preparatory meetings, the first AGS Future Cities Partnership conference was held in Guangzhou in November 2000. It served the goal of establishing a mutual understanding of the problems to be addressed and of the possible contribution of each party. As a result, memoranda of understanding were signed to pursue three interrelated subprojects. The goals and preliminary findings of the sub-projects selected in this phase of the collaboration are described in separate sections of this article. While each project team worked independently with the respective Chinese counterparts – municipal policymakers, planners, faculty and students of local universities –, the findings were discussed in a second international seminar in December of 2001. As the project has received continued funding for 2002 and 2003, this article reports on work in progress.

Fig. 1: Triangle of the megacities.

2 Project Context: Guangzhou and the Pearl River Delta (PRD)

2.1 PRD Development: a Miracle or a Nightmare?

Geographically, the Pearl River Delta (PRD) in the South Chinese province of Guangdong forms a triangle, with the Pearl River as its central component flowing southeast from Guangzhou, and Hong Kong/Shenzhen and Macao/Zhuhai forming the southern boundary (fig. 1). The PRD economic region covers 42,000 square kilometers with a population of 20.5 million in 1993, expected to increase to 28 million by 2010 (Guangdong Planning Commission & PRDEZPO, 1996, p. 93). The development of the Pearl River Delta into one of the most densely populated areas in the world is based on the restructuring of the Chinese economy aimed at encouraging international trade and investment [2]. The amazing economic development of the region is attributed to the Special Policy of 1980, which opened up new options for Guangdong as a result of the following key factors (Chang, 2001, p. 455):

- Freedom to manage foreign trade: i.e. retain more foreign currency, set up promotional organizations and prices in Hong Kong and Macao;
- Fiscal independence: passing on a fixed sum of taxes instead of a percentage of revenue to the central government;
- Financial independence: allowing Guangdong banks to make their own investment decisions. These policies set the stage for the establishment of the Special Economic Zones of Shenzhen [3] and Zhuhai in the southern part of the province.

As a result, PRD has been among the fastest growing areas in China. GDP growth averaged about 13% annually in recent years, with the per capita GDP of the region being more than 3 times the national figure. In 2000, the region accounted for one third of China's total exports and 30% of its total foreign direct investment (Australia-China Chamber of Commerce and Industry, 2002). The physical and economic transformation of this previously fertile estuary for

the production of fish and rice defies description – growth figures can only give a pale image of the actual pace of change and the radical urbanization of the area [4].

The downside of this tremendous growth in population and economic activity is the increased pressure on the environment. Some examples:

- Air pollution from vehicular emissions, industrial operations, power generation, construction activities, and trash and agricultural burning is the most visible and urgent environmental problem. Atmospheric emissions increased by almost 120% in the 1990s. In dense urban areas, carbon dioxide and nitrogen oxide levels have soared with the exponential growth in automobile and truck traffic (Campanella, et al. 2001).
- The amount of domestic wastewater and sewage generated has surged in recent years, with treatment capacity lagging behind. The treatment rate of domestic sewage was only about 9% between 1991 and 1995 (Barron and Steinbrecher, 1999, p. 151). Estimates of how much of the industrial overflow is treated vary from 50% to 85%, contaminating sources of drinking water (Ng, 1999, p. 11). However, environmental regulations and their enforcement vary considerably throughout the Delta.
- Due to the massive population increase and the concomitant decrease in cultivated land, the PRD has changed from a food exporting to a food importing area. In the 1980s alone, use of chemical fertilizers in the Delta increased by 40%.

2.2 Guangzhou – the Pearl in the Pearl River Delta

Guangzhou is the political, economic, scientific, technological, educational and cultural center of Guangdong province. The crisscross waterways of the Pearl River have allowed Guangzhou to become one of the world's large ports. With its role as the center of civil air traffic in South China and a nodal point for national rail traffic, Guangzhou is described as "China's Southern Gate."

When, in 1985, the Chinese State Council designated the PRD as an open economic zone, leading cities in the area like Guangzhou were also declared open zones, along with peripheral cities and open towns placed under the jurisdiction of open cities. With these developments, Guangzhou resumed its historical role as a key city for trade with the outside world.

The ten districts and two county-level towns that make up the Guangzhou municipal area cover some 7,500 km^2, of which the downtown area accounts for about half. The population of the city has doubled in the last seven years to more than seven million people [5]. The growth of the city, however, is not due only to immigration, but also to the incorporation of previously independent cities and villages into the city, thus extending its jurisdiction and sphere of influence, along with increasing its resource base. An example is the city of Panyu on the southern bank of the Pearl River, which was incorporated as a district of Guangzhou in 2000, adding 1.6 million inhabitants, and giving the city access to precious water resources and the opportunity to build a new deepwater port.

Guangzhou's economic development reflects that of the PRD overall. Between 1975 and 1990, spending on urban reconstruction in Guangzhou increased more than tenfold (Chang, 2001, p. 455). Guangzhou's GDP has virtually doubled since 1995. Annual growth rates are in the 13% range. While agricultural output still tends to increase some, growth areas are mostly in industrial manufacturing (crude oils, steel, cement, motor vehicles and motor cycles, cigarettes, beer and soft drinks). The electronic information industry is the fastest growing sector, as Guangzhou has become one of China's three largest Internet exchange centers.

Guangzhou, however, is also at the contributing and the receiving end of the environmental problems the Pearl River Delta has to wrestle with. The subprojects described in the following sections relate to different aspects of the challenges to sustainable development that Guangzhou needs to address.

3 The Residential Housing and Living Environment in Guangzhou

The concept of sustainable development contains two key elements: the essential needs of the population, especially the world's poor, to which overriding priority should be given; and the limit to development imposed by the rate of (natural or managed) assimilation by the counterpart ecosystems (Corson, 1990).

3.1 Upgrading the Standard of Living of the Poor

As to Corson's first element of sustainable development, the Guangzhou governmental housing policy has four objectives: upgrading the standard of living of its residents; achieving a minimum of 15.5 m^2 of livingspace per person by 2010; improving environmental quality; and reducing the population and building density in old districts. Guangzhou faces the same problems of overcrowding as other large cities in the developing world, with population density ranging from 27,000 to 55,000 persons per square kilometre.

According to a 1997 survey, there were 26,000 households with less than five square meters of living space per person. Their income levels were the lowest in the middle and low-income groups. In 1997, the Guangzhou government announced an innovative housing initiative – "Housing Allowance Scheme" (HAS). The main goal of housing reform is to encourage individual home ownership by making the purchase of housing more affordable. Along with HAS, the sale of Comfortable Housing Project units was another focal point of housing reform in Guangzhou [6]. In March 1998, Comfortable Housing prices ranged from RMB 3,000 to 3,500 per m^2 (around US$ 400), compared to the market level of RMB 4,400. The living space of Guangzhou citizens is to increase from 8.92 m^2 per person in 1993 to 15.5 m^2 by the year 2010, with every household having a well-equipped apartment. To reach this objective, Guangzhou needs to build 70 million square meters of new housing with an additional 20 million m^2 for all kinds of service facilities. Because of the high population density,

Fig. 2: Sprawling residential estates at the outskirts of Guangzhou (photo Margrit Hugentobler).

traffic congestion and poor air quality in the downtown area, people became more willing to live in the suburbs. Moving outside of the city is seen as an improvement of the quality of life. Due to this newly generated market, many developers thus began to focus on housing construction in suburban areas. Guangzhou thus began to spread out from the center to the surrounding areas. In the last twenty years, the built-up area of Guangzhou has increased 1.8 times. These trends lead to concerns about the second element of sustainable development.

3.2 Limits of Housing Development

The way in which cities expand and operate has a direct influence on the surrounding eco-system. The housing sector consumes large amounts of energy and other resources in the construction and operation phase. Solid and liquid waste is produced along with carbon dioxide and other noxious emissions. Discouraging high consumption life styles, reducing the use of energy and resources, and maximizing local recycling of waste should also become the essential objectives for sustainable housing development.

Historically, the Guangzhou region, with its subtropical monsoon climate, offered a fertile habitat for a large variety of plant and animal species. In recent years, however, much of the original vegetation and the species relying on it have disappeared as a result of rapid urban development. The forest of the White Cloud mountain, the northern backdrop of the city, is virtually devoid of any animal life.

While newly built housing estates normally have more than 30% of green open space for recreational purposes, little attention is paid to enhancing biological diversity. Rather than using indigenous plants, parks and recreational areas are designed for beauty, their maintenance often requiring large amounts of pesticides with adverse effects on local biological systems. Garden maintenance in new residential areas, mostly relying on the use of tap-water, has driven up water consumption to about 500 liters per day and household, more than twice the national average of 180 to 220 liters. According to national standards, every square meter of green lawn requires two to four liters of water per day.

Little attention is yet paid to the use of environmentally friendly materials in building construction. Aluminum used for window frames is not ecological because of its high energy consumption and pollution in the production process. Alternative combinations of plastic and aluminum are considered too expensive for residential buildings. As clay bricks, another high energy and resource consumption material, have been banned by the government, the use of lightweight foam concrete blocks for non-load bearing walls, is a step in the right direction. Generally, however, recycled materials, except for coal ash, are prohibited in new housing construction by building laws and conventional practices, because of the inconsistency and instability of these products.

While containers for paper recycling and waste separation have been installed in many estates, they are underused and may at best serve an educational purpose. As waste collection, separation and recycling is still a source of income for many poor people, recycling bins are seen as threats to their "business."

In general, Guangzhou still maintains a high density development pattern, which contributes to the efficient use of land and tends to decrease energy use for building maintenance. It helps reduce traveling distances and promotes the use of energy efficient means of transportation (buses, trains), thus decreasing energy use (Norman, 1996; Naess, 1995). High density also offers the potential for interaction among people as individuals and groups.

In summary, current housing development is focused on meeting the needs of a growing population and its demand for more living space in a process

Fig. 3: Traditional Ling-Nan garden in a large residential estate (photo Beisi Jia).

where the market plays an increasingly important role. The ecological dimensions are still largely neglected, both in housing construction, maintenance and in development patterns that contribute to urban sprawl.

While traditional architecture characterized by two- to three-storey courtyard houses has lost its usefulness in the modern, rapidly growing city, some developers have become sensitive to traditions in the design of green space and communal facilities. In Riverside Gardens – a large housing complex, a typical Ling-Nan garden offers flowers, bushes, and trees providing shadow, but no lawn or grass requiring large amounts of water (fig. 3). A shopping arcade, added at the street level of residential buildings, modeled after local street patterns in Guangzhou, offers basic goods, encourages social interaction and provides protection from sun and rain. The concept paid off – 200 flats were sold in one day, a record sale since the company was founded.

3.3 Where Worlds Clash: "Villages in the City"

There are some 138 so called "villages in the city" of Guangzhou. These villages with more than one million inhabitants, historically relatively self-contained political and economic systems with a largely agricultural population, still covered 11.6% of the built-up area of Guangzhou in 1997 (Guangzhou Construction Commission). Many of these villages have become seemingly out-of-place witnesses of a world past in a 21st century metropolis.

In 1989, Beijing issued the Law of "Transfer of Land-Use Rights," regulating the use of the land outside the Special Economic Zones. It allocated one hectare of land to each household as a source of wealth. In urban areas of the Pearl River Delta, the value of farmland skyrocketed. Farmers, now entrepreneurs and landlords overnight, individu-

Fig. 4: Newly constructed Shadong Village (photo Margrit Hugentobler).

ally and as collectives lent their land-use rights to developers (Craciun, 2001). With the rapid expansion of cities like Guangzhou, many villages were razed to the ground to give way to high rise buildings for commercial and residential use. The villagers, often handsomely compensated, were moved to newly built subdivisions at the edge of the city. Though living in comfortable homes, old farmers we talked to seemed lost and oddly out of place. The social fabric of family clans and communities – evolved over hundreds of years – was destroyed over night, along with it the many small scale income generating activities (repair shops, small factories, food stands, restaurants, etc.) that had been part of the economic base and social life of the historically grown village structures.

In negotiating the content of the AGS-Guangzhou partnership project, Guangzhou city officials proposed to the ETH Zurich team that they should act as consultants on the renewal of Zhu Village – one of the villages in the city. Rather than demolishing it, new ways should be considered to improve the appearance of the village and plan its future development. While the motivation behind this new urban development strategy was never made quite clear, an agreement was reached, and publicly supported by the Vice-Mayor of Guangzhou. Under the agreement, Zhu Village should become a model project for village renewal, from which lessons could be applied to other village renewal projects in the city.

3.4 Zhu Village

Zhu Village is located at the edge of Tianhe District in the eastern part of the city, and destined to become the city's new commercial and administrative center. The vision is well on its way to becoming reality (fig. 5). Shiny glass facades mirror the post-modern architecture of office towers – in the prevailing pink and green colors. Hotel lobbies half the size of a football field open onto large park creations with little shade which would invite people to linger. Tianhe District advertises itself as a glitzy "new world" – defying any notion of China as a so-called developing country.

Leaving the busy four-lane highway that connects Zhu Village to the City, a modern arch symbolizes the gate to a different world, where the pace of life suddenly slows. Behind a big open market with small booths – an outdoor extension of the large store behind – lies the village administration building, next to a large school with adjacent playgrounds and soccer fields. None of these buildings is more than five to ten years old, the architecture uninspiring, the facades finished in the typical white tile. Past these buildings, a different world begins to take shape. Two- to three-storey older residential buildings are connected to the street by small concrete overpasses. The canal they bridge carries not so much water as discarded PET bottles, cans and other disposables of civilization. A few steps further, an unexpected view of a pond surrounded by white and pink tile-finished buildings of varying heights, which seem to double in size with their reflection in the water. A huge bunyan tree at the far end of the pond, interspersed single-storey brick houses and the outwardly tilted roof of an old temple lining the small path along the water complete the picturesque impression. "Little Venice," as one visitor from Europe exclaimed spontaneously. There is indeed a very attractive visual quality to this place and some other similar locations in Zhu Village

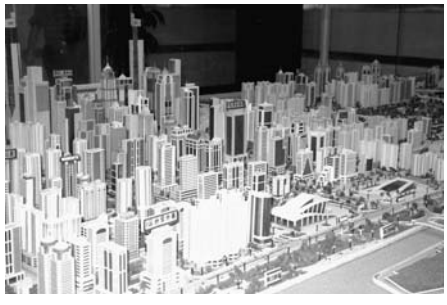

Fig. 5: Model of Tianhe District (photo Margrit Hugentobler).

Fig. 6 to 9: Qualities of Zhu Village: trees, water, historic buildings, public places (photos Werner Stutz).

(fig. 6 to 9). It is not so much single characteristics that are appealing, but the combination of features that defines the qualities of these places. Upon closer inspection, the temple roof needs repair, the edges of the pond are laced with more bottles, cans, paper wrappings, and cardboard floating on the water.

3.5 Discarding the Grand Plan in Favor of "Soft Renewal"

In the initial project phase we defined our role as consultants who would provide stimulation and input, while the

planning work would be done locally. In a workshop with city and village officials, we proposed a systemic way of approaching the issue of the Zhu Village renewal from a sustainable development perspective based on a conceptual framework developed by ETH Zurich Wohnforum to analyze successful urban planning projects (Hugentobler and Brändle-Ströh, 1997). The framework differentiates the well-known tenets of environmental, social and economic sustainability along the lines of a systemic approach, raising questions about sustainability related to chemical/physical, biological, human (individual), social and cultural systems.

In a second phase of the project, a team of architects and sociologists from a local university developed an extensive inventory of the physical, economic and social characteristics of Zhu Village (number and type of housing, historic buildings, the organization of economic activity, sources of income, etc.) [7]. Based on the physical inventory, they proposed a four-phase re-development plan which, upon completion, would have radically altered the existing spatial features of the village and its unique qualities. While the inventory proved very valuable, the development plan met with many critical questions by the Chinese policymakers as well as our research team. The plan was expensive, reflected much of the greenfield approach to new residential housing design, and offered little in terms of sustainable development qualities.

At this point, project decision and management responsibility was shifted to the (Tianhe) District Level Government, while top city officials pledged their continued support for the project in view of its model character. At the same time, we were asked to change our role by proposing planning guidelines and offering more substantive input for how village renewal could be approached in a more creative and sustainable way. The planning guidelines subsequently discussed with the Chinese project partners in a third phase of the project included the suggestions

- That the model character of the project (to be transferable) should focus on and document the process of planning and implementing changes;
- Planned changes should be approached in a step-by-step fashion, starting with key problems and interventions in order to be realistic in terms of resources required;
- A successful and encompassing approach to sustainable urban renewal would require participation and commitment of the many actors involved (city, district, town and village level government, as well as the villagers themselves).

It was agreed that rather than starting with an overall development plan, a number of locations, characterized by the special elements of the village – historical architecture, public/recreational space, water and trees – should be selected as target areas for intervention. For this phase, the ETH Zurich team would bring in experts in historic monument preservation and biological water treatment methods in order to provide suggestions for which locations to select and what renewal, renovation and remediation strategies might be chosen from a sustainable development perspective. This work is currently going on and will provide the basis for discussion with the local project group on how to proceed (fig. 10). By planning for exemplary improvements, the intention is to create a dynamic impetus for further changes

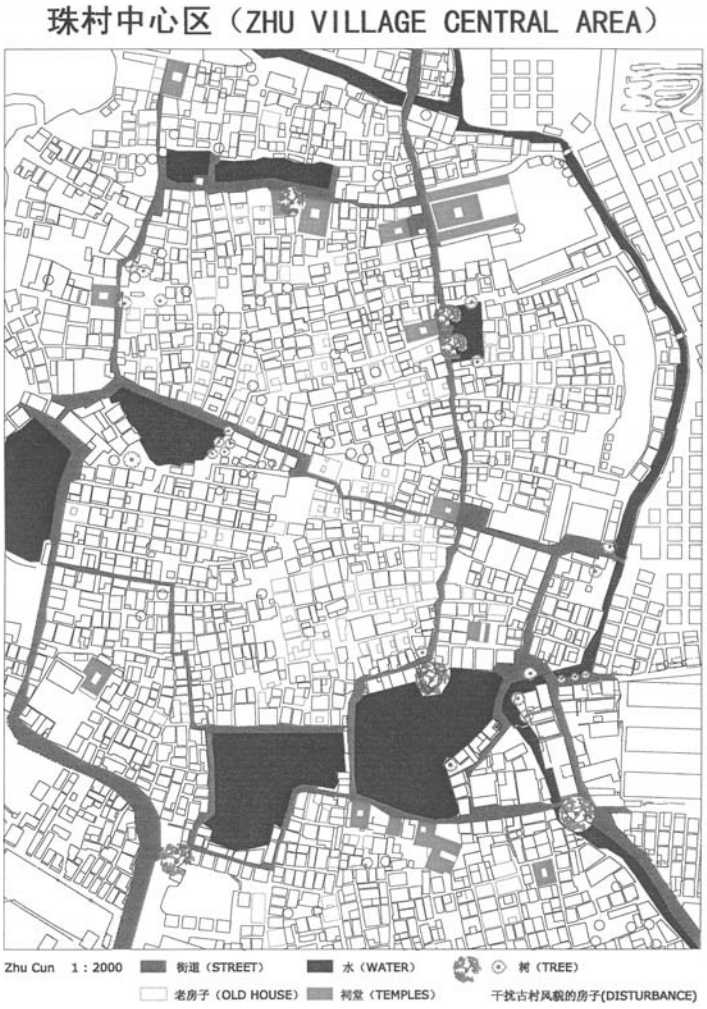

Fig. 10: Inventory of areas proposed for protection (Werner Stutz).

4 Transport Management in Guangzhou

Of the many daunting challenges the world's developing megacities face, perhaps none is more pressing than the urgent need to enhance the mobility of citizens. An efficient flow of goods and people into, around, and through these urban nerve centers is vital to their global economic competitiveness, environmental health, and socio-economic development. A lack of adequate mobility is characterized by a number of detrimental externalities. Chiefly, ensnarement of vehicles in traffic congestion, an increase in air-borne pollutants and higher cost of travel are symptoms of poor planning, inadequate invest-

ment, and ineffective governance. Innovative policies, regulations, and technologies must be employed that enable mobility without sacrificing quality of life, clean air, or investment sectors.

Over the past two years, we have worked closely with the municipal government in Guangzhou to develop environmentally sustainable, socially equitable, and financially self-reliant transportation policies and systems [8]. This objective is achieved by first reviewing and assessing a portfolio of urban transportation policies, regulations, and technologies (concentrating on those policies that make use of market forces to influence travel demand), and then, by developing a series of urban transportation policy recommendations for the city of Guangzhou. Our recommendations are based on interviews with senior municipal officials, documents produced by the administration, the city's unique context, and the experience of other megacities throughout the world.

Our research started by reviewing the context in which the policies, regulations, and technology have been employed in megacities. This was achieved by examining the demographic, economic, political, and environmental setting in which these systems have evolved. Subsequently, an examination of the municipal institutional structure, for example, helped us to identify the organizational constraints in which policies were formulated and executed. We addressed the following questions: What institutional mechanisms were developed or reformed in order to facilitate the planning and execution of transportation policies? How did institutional structure affect the capacity of these organizations to develop and implement the policies?

What role, if any, can the private sector have in providing alternative institutional structures to provide services that are typically assumed by the public sector? Similarly the specific policies, regulations, and technologies that these cities have employed to further their objectives were examined: each policy description was followed by a four-part analysis, which appraised the impact of these strategies operationally, economically, environmentally and socio-economically.

Operational evaluation measured the programs effectiveness in achieving its basic operational goals. These goals are often performance-based criteria such as increased average travel speed, greater capacity, or a measure of voluntary compliance with a regulation. An analysis of the costs, financial mechanisms employed, and the economic impact of the policies and programs in other megacities provided the basis for financial and economic evaluation. From an environmental perspective, the urban transportation policies and strategies were considered within the broader context of the environmental impact associated with them.

In terms of socio-economic evaluation, the challenges surrounding equitable cost distribution, with regard to tolling and taxation policies, and the difficulty of capturing secondary economic benefits were addressed. It was demonstrated that compliance can be bolstered by ensuring that an equitable distribution of costs and benefits is realized. We also investigated methods by which accountability and transparency have been used to garner public support.

Three primary conclusions arise from this study. First, Guangzhou, similar to many developing megacities, cannot focus solely on the supply of additional infrastructure to address its mobility problems; it must also manage the demand side of the equation. Second, Guangzhou must employ a broad mixture of demand-management measures simultaneously in order to significantly improve mobility. Third, it must develop adequate institutional capacity in order to design, implement, enforce effective transportation policies and manage sustainable urban transportation systems.

5 Sustainable Water Management in the Panyu District

The newly included area of Panyu (located directly south of Guangzhou) has entered into a very rapid phase of industrial and residential development. In December 2000, the Central People's Congress of Beijing approved a development plan to transform the Panyu District into a new industrial and domestic platform for the city of Guangzhou to be completed over the next fifty years. Six key development regions will form the foundation of the plan: the northern region, which includes the construction of a university town and the northern adjustment region; the central region, which includes the construction of Guangzhou New City and Shiqiao City adjustment region; and the southern region, which encompasses the Nansha Economic and Technological Development Zone, involving the construction of a deep water harbor on Longxue Island, and the middle agricultural region.

The goal of this subproject was to predict the future water quality of the Shawan River in the Panyu District, with relation to changes in the water quantity utilized to fuel industrial and domestic development up to the year 2050. The analysis was to assess the sustainability of the development and the necessity of countermeasures. [9]

The total land area of the Panyu District is 1313.8 km^2, of which approximately 65% or 852.3 km^2 is land and 35% or 461.5 km^2 is made up of waterways and external water regions. Within the Panyu District, six key development regions will be formed, with each region serving a predetermined function:

- North adjustment district: at present this area is an important industrial base located just south of Guangzhou city. It will not be developed beyond current levels.
- Shiqiao adjustment region: this region also will not have a high level of development, but will form the center for governmental administration, transportation, and the exchange of goods.
- Guangzhou University Region: this region will be developed into the new base for education, research and hi-tech facilities.
- Guangzhou New City Region: this region is to become a new center for commerce, residential housing and tourism.
- Nansha New Harbor Area, including the Nansha economic and technological development area, and the Pearl

River Management area will be a center for transportation, goods and service exchange, heavy industry, IT industries, and harbor industry. It will form an important link between Guangzhou and Hong Kong.

- Agricultural Region: this region will be the focal point of agriculture in the Panyu District, and will also be used as an important food processing and chemical production region.

The Panyu area is characterized by several rivers in the tidal area. The Shawan River, located in the center, the confluence of the Shunde River and the Chencun Rivers, flows in roughly a west to easterly direction, ultimately discharging to the Shizhiyang River, which forms the last section of the main channel of the Pearl River. Being located within the Pearl River Delta, the Shawan River is part of a large network of interconnected streams and waterways. The total length of the Shawan River is 25.7 km, with an average width of 300 to 600 m, and an average depth of 5 to 9 m. It is also subject to tidal interactions (ebb and flow) twice a day.

In order to predict the water quality of the Shawan River, two scenarios related to wastewater management for the years 2020 and 2050 were defined:

- Worst-case scenario – wastewater is not treated before discharge into the river. Not knowing accurately what industrial activity is likely to be located in the Shiqiao Adjustment Region and Guangzhou New City Region, it was assumed that no industrial wastewater would be returned to the river. Therefore, the pollution load would be predominantly from domestic wastewater.
- Best-case scenario – wastewater treatment, including a high degree of tertiary treatment, is used to remove 90% of the pollution load. As in scenario 1, the effect of industrial wastewater was not included.

The period of simulation was for the years 2020 and 2050. Three flow rates were used in the evaluation: the 90% probability of the month of lowest flow (37.2 m^3/s); and the range of flow rates within the low flow period, which is the dry season from November to February (307 and 432 m^3/s). Subsequently, two countermeasures (industrial and domestic water savings) – sustainable initiatives – were nested within the two scenarios to ascertain improvements in water quality as a direct result of reduction in water quantity. The industrial water saving countermeasure showed the greatest improvement in water quality. For the 90% probability of lowest flow for the worst-case scenario, this countermeasure equated to a 63% decrease in the amount of oxygen consumed (BOD). For the low flow rate periods, the background concentration of pollutants had more influence on the future predicted water quality than improvements obtained by the countermeasures. It was recommended that care be taken to safeguard the flow rate of the river, as the most noticeable changes occurred when the flow rate was low. In order to avoid this situation, industrial countermeasures appeared to have the greatest impact. Industrial countermeasures recommended were water saving, water recycling, the use of brackish water for cooling, and the implementation of economic pricing initiatives. In addition, inter-district governmental policies should be initiated to prevent upstream pollution from affecting downstream strategies, further enhancing the sustainable water management of the Shawan River.

6 Conclusions

Establishing a partnership between research teams from three different countries and several disciplines with municipal policy makers and planners in yet a fourth country was indeed a challenge. Geographical distance, language barriers, and the obvious as much as the subtle cultural differences in working styles and planning horizons require patience, persistence and openness in order to build trust and some measure of a common understanding of the issues to be addressed.

Common to the three subprojects was that they picked up on issues and concerns raised by Guangzhou government officials, and that the results of the work done both by AGS teams as well as Guangzhou researchers and planners were presented and discussed on the occasion of a joint conference in Guangzhou. Yet, there were some differences in the role definition by AGS teams. The work of the American and Japanese team focused on know-how exchange and transfer by collecting and analyzing local Chinese data and relating it to experiences from and methods used in other settings. Resulting recommendations with regard to policies for transportation demand management or measures for future water resource management are thus to some degree transferable to similar issues faced by other large cities. By contrast, the work of the Swiss team was more process-oriented. The focus of the first project phase was to develop a common conceptual understanding of how to approach the problem of sustainable urban renewal from an encompassing perspective – involving physical, social, economic and cultural aspects. The know-how generated from this model project thus focuses more on planning and implementation processes rather than on specific content, as local characteristics vary in each urban neighborhood.

Quite obvious, but no less important is the conclusion, that most of the challenges to sustainable development Guangzhou faces are regional in scope and cannot be solved effectively within the city's institutional and territorial boundaries. New forms of planning and institutional cooperation among cities and provincial governments in the Pearl River Delta are required. While this is particularly true for environmental issues such as land-use and air and water pollution, it is also relevant for the social tensions emerging in a regional society, segregated into increasingly well-off citizens and large numbers of poor migrant laborers, who, working in the factories and the construction trade, contribute much to the wealth created, with little gain for themselves.

Notes

[1] This cooperation resulted in the edited volume "Future Cities – Dynamics and Sus-

tainability" (2002). Moavenzadeh, F., Hanaki, K. and Baccini, P. (eds). Dordrecht: Kluwer Academic Publishers.

[2] The roughly 700 persons per square kilometer contrast with about half that number for Guangdong Province and about 133 for China as a whole. National Academy Press (2001). Growing Populations, Changing Landscapes. Washington.D.C.

[3] Shenzhen, little more than a fishing village in 1978, is now one of China's most prosperous cities with a population increase-from 20,000 in 1979 to more than 3 million by the mid-1990s (Campanella, T.J., et al., 2002).

[4] The Great Leap Forward (2001) provides a visually impressive picture of the transformation of the Pearl River Delta during the last decade.

[5] This is the official population figure according to the Guangzhou Municipal People's Government for 2001. As rural immigrants (transient laborers) are usually not included or underestimated in official figures, estimates of the total population of Guangzhou by other sources are closer to 10 million.

[6] In 1995, the State Council announced the "Implementation Plan for the National Comfortable Housing Project." Fifty-nine cities were selected to carry out experimental housing projects. Comfortable Housing is built for middle and low income groups whose living area is less than 4 m^2 per capita. The Project is regarded as a focal point of urban housing reform in the next five years.

[7] For a description of Zhu Village, its spatial structures and political and economic organization, see Luetolf T. (2002): Zhu Cun – A Village in the City. Department of Architecture, ETH Zurich. A postgraduate thesis produced in conjunction with this AGS project.

[8] This part draws on the master's thesis completed in conjunction with this AGS project by Cheatham B.M. 2001. Sustainable Urban Transportation in Developing Mega-Cities: A Review of Policies, Regulations and Technologies. MIT, Boston.

[9] The authors would like to thank Dr. Toshiya Aramaki and Mr. James Eastcott for their contribution to the data collection and analysis for this project.

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Priming Sustainability: The Kunming Urban Region Development Project

For the last ten years, the city and region of Kunming has been marked by rapid urban growth and a strong trend towards modernization. Until 2020, the economy is expected to expand strongly and the city's population to double. Such a pace of growth normally leads to a situation in which issues related to society, the environment, and issues of cultural heritage are increasingly neglected.

Due to these dramatic circumstances, the city partnership between Zurich and Kunming, which has been in place since 1982, developed gradually from a cultural exchange into an intensive technical cooperation between the two cities, aimed at steering the strong development of Kunming toward a more sustainable path. With the involvement of the Swiss Development Cooperation (SDC) and the ORL Institute at the Swiss Federal Institute of Technology (ORL-ETH), three phases of the overall project for the Kunming Urban Development and Public Transportation Masterplan (KUDPTM) have been carried out. The main contents of KUDPTM were regional development, traffic management and public transportation, urban landscape planning and networking and dissemination.

Main successes were the implementation of the first bus line in China and the now ongoing efforts to establish a strong regional public transport system. Furthermore, the project-based collaboration during the last nine years has strongly contributed to the improvement of the urban planning and management skills of Kunming's officials, especially when dealing with sustainability issues.

1 Introduction: Framework of the Kunming Urban Region Development Project

1.1 Project Background: Environmental Situation, Urban Dynamics and Institutional Framework

The past two decades of rapid economic growth, industrial development and large scale urbanization in China have been accompanied by serious environmental degradation. Soil erosion, consumption of prime agricultural land for urbanization, deforestation, and damage to both wetlands and grasslands are widespread. The levels of air and water pollution are among the highest in the world.

Urban expansion is accompanied by accelerated population growth characterized by a large floating population, high levels of unemployment, and a growing gap between haves and have-nots. Thus, additional threats are posed to the human and natural environment. Just as an example, inside the Greater Kunming Area (GKA), the surface of built areas virtually doubled between 1980 and 1997, increasing from 138 to 260 square kilometers while the population grew from 1,7 to 3,2 million. Additionally, about a million members of the floating population were present in 1997. If current trends prevail, it is expected that the built areas will have exceeded 600 square kilometers in 2020, mono-centrically organized around the downtown area, while the population will at least double again. In such a scenario, large areas of fertile land would be consumed by urbanization. The transportation infrastructure would be mainly car-based, which would result in high levels of land consumption and air pollution, as well as a reduced accessibility to the city center due to congestion. Furthermore, poor housing conditions, outdated production facilities, rising levels of consumption, inadequate infrastructure and limited environmental carrying capacity threaten to exacerbate urban environmental deterioration.

However, as the city and region around Kunming have started to develop rapidly since the beginning of the 1990s, the regional dynamics of Kunming can still be guided, and there is a good chance that many future negative developments can be avoided and local and regional potential can be tapped if proper, sustainability-oriented planning is implemented. In this sense, Kunming is just one of many cities in China and Asia facing similar conditions.

The government of the People's Republic of China (PRC) has taken vigorous steps to address the challenges of environmental pollution and uncontrolled urban growth. In 1994, the State Council called on national and local governmental units to implement China's Agenda 21, integrating sustainability objectives into each level of planning. However, implementation has so far been limited because on the one hand, planners and decision makers were not conscious of the serious risks posed by unguided urban development and were often attracted by short-term benefits without considering the long-term consequences.

On the other hand, in the prevailing legal framework, different planning levels were incoherent and overlapping. In addition to this, comprehensive local planning, which would allow an integrated approach addressing the whole territory (landscape as well as settlement areas), is so far not existent in the PRC. In countries in the western hemisphere, this planning level is regarded as the main pillar of spatial planning.

Furthermore, among the administrative bodies concerned with spatial planning, there is a strong sectoral division and therefore a lack of coordination. This is very well illustrated by the absence of a spatial planning law, which among other functions should regulate the responsibilities and duties of the various government institutions.

Thus, spatial and environmental management in the PRC is not only constrained by the lack of financial resources and inadequate professional capabilities, but also by poor coordination between local and central government and between government administrations on the same level, which causes, among other things, weak and ambiguous enforcement of regulations.

When dealing with urban and regional development in China, one of the top requirements is thus not to address only one single issue or planning level, but the urban system as a whole, including its institutional aspects

1.2 The Project "Carrier": the City Partnership between Zurich and Kunming

1.2.1 History of Cooperation (1982 to 2002)

The city partnership between the cities of Zurich and Kunming was started in 1982. However, at that time it was a classical city partnership limited to cultural exchange. Nearly parallel to Kunming's rapid urban growth, which started at the beginning of the 1990s, the partnership developed into an intensive technical collaboration between the two cities, which was built up in different phases:

- Between 1987 to 1994, the main focus of attention was on water supply and waste water disposal.
- This limited approach was widened in 1993. The new approach included public transportation as an important component of sustainable urban development and resulted in a *Masterplan for Public Transportation*, completed in 1996. This masterplan foresaw phased development of combined bus, tram and rapid rail transportation networks with an appropriate traffic management program.
- In 1996, a multi-component package started to steer the urban dynamics of Kunming on a more sustainable development path and to support the realization of the Public Transportation Masterplan. In this phase, the Swiss Agency for Development and Cooperation (SDC) started to be involved, on the one hand supporting the activities of the City of Zurich in Kunming and on the other, by initiating a training and research project, which was operated by the Institute of National, Regional and Local Planning of the Swiss Federal Institute of Technology, Zurich (ORL-ETH). This phase encompassed the design of the first light rail transit (LRT) line, a demonstration high-capacity bus line, and related traffic management measures. To promote appropriate linkage between transportation and urban development, reduce the demand for mobility, and improve environmental quality, the project also included technical assistance in urban landscape planning, regional and environmental planning, and in managing sustainable urban development.
- From 2002 to 2005, the work in the different project components will be continued, completed and consolidated. Furthermore, it is intended that the KUDPTM pilot experience be further elaborated to serve as a model approach towards sustainable urban development. The project-based collaboration during the last nine years has strongly contributed to the improvement of the urban planning and management skills of Kunming, especially with respect to sustainability issues. The to date impressive progress of Kunming permits us to assume that after 2004 the planning administration of Kunming will gradually be able to steer its urban and regional dynamics by itself. Therefore, after 2005, no further assistance phase – but an alternative way of collaboration, a kind of a forum dealing with urban development problems on both sides – is foreseen.

1.2.2 The Political Status of the City-Partnership and its Influence on Cooperation

The city partnership between Zurich and Kunming has now been in place for 20 years. This fruitful partnership is well established in the local political network: Project leaders on the Swiss side now have direct access to the main political decision-makers. This makes for easy coopeoration – especially when strategically important decision making is needed.

Furthermore, this long lasting partnership has created confidence and friendship between the responsible actors on both sides, an important precondition for open discussion of problems. Besides cooperation work, where experience from developed countries was mixed with Chinese behavior throughout the project elaboration process, the more social events of the city partnership contributed to a better understanding and to direct contact between experts and political leaders and decision-makers. The visits of Chinese leaders in Zurich and in other European cities further contributed to a good understanding.

- Thus, the influence of the city partnership on collaboration is considerable and extremely helpful, especially when the goal is to implement projects. Implementation is usually the most critical moment in the life of a planning project. It is also the most important, because a planning project that is not implemented has no value. In critical moments, such as when the implementation decision was pending – for example for the demonstration bus line – this partnership has influenced decision-making very positively and brought the project to a good end with success for everybody involved.

1.3 The Cooperation Mode: Comprehensive, Bilateral, Bottom-up and Top-down

The City of Zurich experienced its greatest development phase between 1970 and 1990 with the construction of the highway network (until 1980) and the establishment of the high capacity short range railway system (S-Bahn, until 1990), when it basically developed from a city to an urban region (Greater Zurich Area). At the beginning, the region experienced all the negative impacts of suburbanization and car-based development, which cumulated at Zurich City proper. Since 1985, the city government has implemented concrete measures to make the city development more sustainable, and to improve the quality of life in the city center. These multi-phased and multidisciplinary efforts were very successful and contributed a great deal to the current reputation of Zurich as a highly efficient city with an excellent quality of life. During this process, high grade know how on transportaton, city and regional planning was accumulated from projects which met with international recognition. [1]

It is now interesting to see that later on many of the personnel from Zurich's institutional bodies, who participated as engineers or planners in the build-up of Zurich's transportation and planning systems, were engaged as experts and were consulted on the development of Kunming. The technical know how, the personal engagement and enthusiasm of many of these experts (and politicians) impressed and enthused their Chinese counterparts, who were later responsible for implementation.

These consultations were usually organized as comprehensive workshops, held twice a year, either in Kunming or in Zurich. Swiss experts met with their Chinese counterparts and together discussed and developed projects on different planning levels. All these workshops were multidisciplinary and organized as discussion and project forums. They included the political decision-makers, the heads and some staff from various planning departments (urban planning, transportation planning, railway department, land administration, etc.), and local leaders from the respective areas. At the end of each workshop, a project booklet explaining planning intentions, concepts and projects was finalized and handed over to the political decision-makers.

Besides workshops, visits were organized to broaden the experience and knowledge of Chinese politicians and technicians, to convince them of the necessity and effectiveness of the suggested measures and projects, for which they would be responsible.

When the complexity of a project required greater assistance – as in the case of the projects involving installation of separate bus lanes and tramways – one of the Swiss experts was transferred for two years to Kunming to guarantee continuous assistance.

Furthermore, scholarships were granted to talented members of Kunming's planning administration to improve their planning know how.

2 Project Components of the Kunming Urban Region Development Project

2.1 The Regional Development Component: Encompassing the Development of a Region as a Whole

The overall goal of this component is to strengthen local and regional planning as an integrated and comprehensive planning process and to support the planning authorities in Kunming in dealing with complex urban and environmental challenges.

The regional development component was initiated mainly because the urban dynamics of the city of Kunming started increasingly to affect the surrounding rural hinterland. Indeed, this area, named the Greater Kunming Area (GKA), which encompasses the most sensitive natural areas, including the Lake Dian Watershed Region, just started to be involved in Kunming's urbanization process. The risks of loosing huge amounts of prime arable land and greatly increasing environmental pollution were obvious.

GIS-based modelling of future settlement development showed that through the development of a strong regional public transportation system, for example a high capacity short-range railway system, and its close coordination with a decentralized but dense settlement pattern, land-use and transportation-related emissions could be reduced by about one-third. In addition, the various urban centers in Kunming Prefecture would be directly interconnected by this system. This would result in a modified settlement pattern, which would make the various urban centers in the Kunming region easier to reach, and would allow the region as a whole to function more efficiently.

To reach this goal, the adoption of sustainability-oriented planning policies [2] and the implementation of a GIS-based comprehensive surface-covering planning system has been suggested to the city and its region, the Greater Kunming Area (GKA). In principal, it includes the following steps:

- Setting up the legal and administrative framework as a base for the implementation of comprehensive planning.
- Individual definition of guiding and planning principles for the planning units on the regional, subregional and local levels.
- Stepwise implementation of regional, sub-regional and local surface-covering planning, by using cross-sectoral and multidisciplinary approaches.

In detail, the following subprojects were carried out:

- Suggestions for the reform of the current planning system (implementing comprehensive planning in PRC): Detailed research on the current planning system has been undertaken and suggestions for its reform have been forwarded. These suggestions have been taken up by all the following subprojects.
- Implementation of a GIS-based comprehensive regional, subregional and local planning: In China, spatial planning is so far limited to the restricted master plan areas of Kunming and to the towns where the county seats are located. Comprehensive planning approaches that cover the whole area – both, urban and rural – are so far unknown in the PCR. To attain better sustainability; however, it is necessary that regional dynamics be guided and that urban and rural development be coordinated.

To demonstrate how this could be done, GIS-based comprehensive regional, subregional and local guiding plans are at work (see fig. 1), which shall coordinate space-relevant functions and ensure the protection of fertile land and other natural assets. In addition, the database can be used to monitor and control urban development. Pilot projects illustrate further how a surface-covering and sustainability-oriented local planning policy can be implemented.

- Monitoring and controlling of urban and regional development: This subproject was started because planning alone is not sufficient. Verification of successful implementation of suggested measures and confirmation of whether goals set forth in planning documents have been attained are also necessary. The subproject includes tools designed to assess if development goals are met and to monitor the overall environmental situation

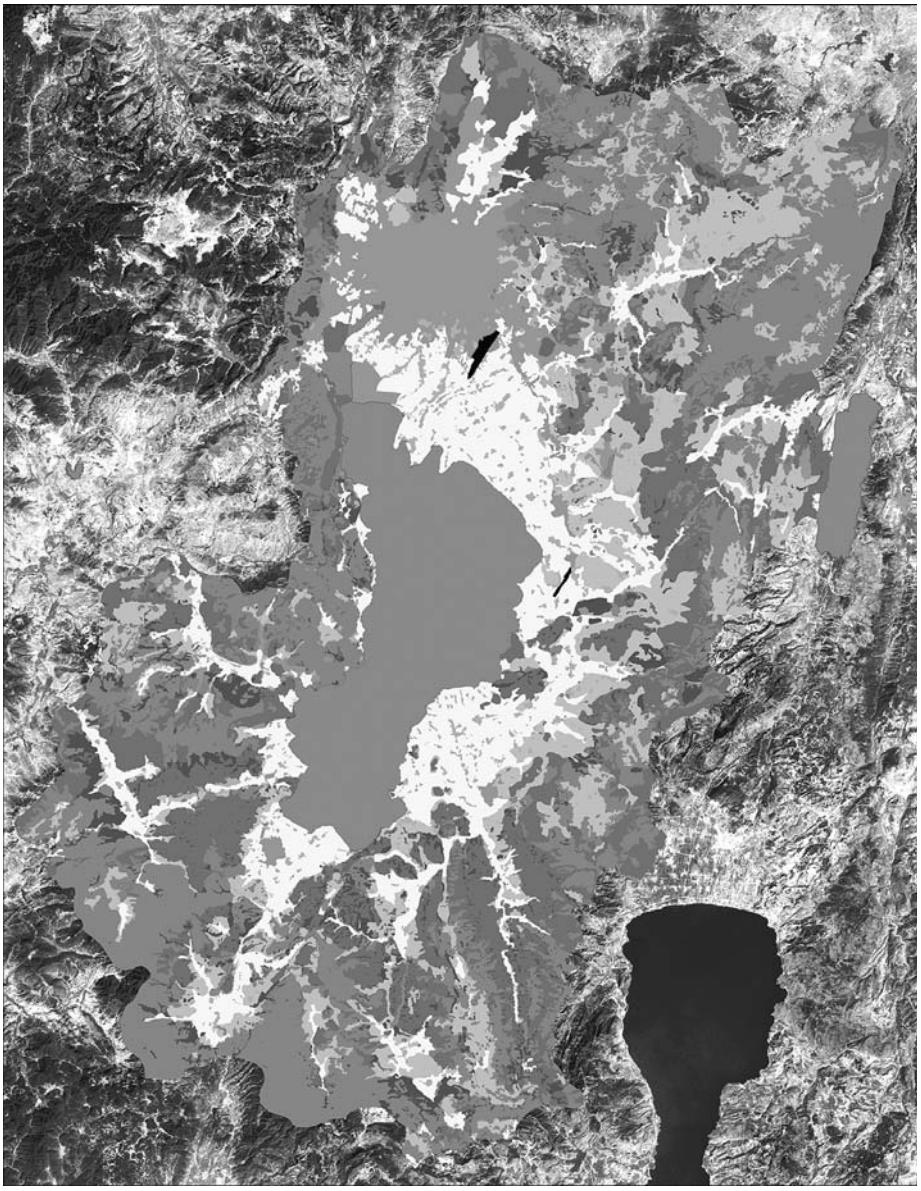

Fig. 1: Regional guiding plan for GKA: settlement and landscape.

and is essentially based on sustainability indicators. It will be used for monitoring environmental conditions in the GKA and will be applied in future planning and decision-making processes.

- Regional Economic Development Strategy: To put space-related decision making on a solid base, a Regional Economic Development Strategy has been developed for Kunming. It places the comparative economic strengths of Kunming in a national and international context. As a result, the city will be able to concentrate its funds on its principal strengths and adjust its spatial development accordingly.

2.2 The Transportation Planning Component: Focus on the Environment

Modern public transportation has neither a long history in China nor well established models to follow, nor are the reasons and necessities for it really known. Thus, public transportation planning is neglected in many Chinese cities, despite its strategic importance. However, during the elaboration of the first Master Plan for Public Transportation, the suggestions of the Swiss experts made during the workshops were taken up and developed further by their Chinese counterparts. These include:

(i) Technical assistance

- In the planning and implementation of public transportation facilities, to enhance Kunming's capacity to plan, implement and operate efficient public transportation systems and conduct effective traffic management.
- In traffic management issues such as organizational questions concerning, for example, the street network, design of intersections, and operation of the street network.
- In implementation of high-capacity bus lines (the first line is already in place, three more are to follow), the first tram line, and rapid short-range passenger railway system.

(ii) Introduction of new traffic management concepts, such as the implementation of a modern transportation management strategy that promotes

- Public and unmotorized transportation.
- Priority to pedestrians in the central zones of the city, as well as in residential areas.

(iii) Linkage of public transportation and settlement infrastructures, particularly the linkage of new satellite cities with the high capacity short-range railway system.

An interesting detail was that at an early stage the collaboration in multidisciplinary project teams brought together the urban planning bureau and the railway authority, which now collaborate closely, especially on the Kunming-Songming and Kunming-Anning settlement axis. Previously, such collaboration was simply unthinkable. In general, the multidisciplinary cooperation on transportation-related issues between Swiss and Chinese, between the traffic police, the transportation and planning departments of the urban planning bureau, the railway authority, and the other local authorities, was impressive and led quickly to good results. In addition, awareness-raising among the concerned governmental agencies is a very important issue. These have to be helped to understand why public trans-

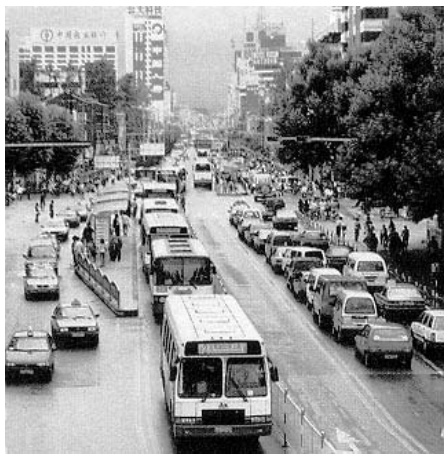

Fig. 2: High-capacity bus lane: Beijing Road.

portation is crucial to the development of modern, sustainability-oriented cities.

2.3 The Urban Landscape Planning and Design Component: Establishing and Preserving Urban Identity

With the incredibly rapid urban expansion which has occurred since the beginning of the 1990s, the massive raising of skyscrapers, primarily in the city center, and the gradual destruction of the historical part of the city, it became obvious that the dangerous monotony and lack of orientation in planning, which has unfortunately become quite typical for many of China's larger cities, will take place in Kunming as well. To preserve the remaining structural heritage and create an individual modern face for Kunming, the urban landscape planning and design component was initiated. It is divided up in the following items:

- Urban planning,
- Urban landscape design,
- Historic city preservation.

Urban planning started with the planning of the city center and was gradually extended to the other areas of the Greater Kunming Area. It included strategic locations such as the South Railway Station, and the planning of new city extensions such as the north town or Kunming Southeast. Interesting details in this regard were the new town center and the structural pattern of this city extension, where special emphasis is placed on creating a strict, but interesting pattern to prevent monotony (see fig. 3). In Kunming Southeast, an existing settlement had to be restructured and refocused toward the nodes of public (railway) transport.

What began with Kunming Southeast – the support of spatial development, which is conducive to public transport – was driven much further during the planning of the settlement axis from Kunming to Songming (to the east) (see fig. 4) and to Anning (in the west). Here, a main focus was to demonstrate the close dependence of transport planning and settlement development and how public transportation and the settlement pattern could be optimally coordinated.

Both projects were no longer urban planning projects in the proper sense, but included more and more landscape planning and landscape design components. This fact was illustrated during planning of the Lake Dian Eastern Shore, which was done in close cooperation with ORL-ETH on the basis of its established geographic information system (GIS) based modelling of settlement patterns and their land-use and environmental planning maps. Indeed, the more this project advanced, the more environmental planning and urban landscape planning united.

Unfortunately, when Zurich's Department for the Preservation of Historic Buildings and Monuments came to Kunming in 1997, a large part of the old town had already been sacrificed to the ongoing enormous building boom. Meanwhile, Kunming has recognized the cultural value of the remainder of the old town and in 1997 declared it a protected area. Since mid-2000, a historic city preservation office dedicated to the preservation of the old town has been established in Kunming, for which counterparts in Zurich act as advisors. Since then, different pilot projects have begun (see also Stutz [2002] in this issue of DISP).

2.4 Dissemination and Networking: Multiplying the Results

The project's impact on awareness, practice and policies for public transportation and sustainable urban development will be enhanced through increased networking activities, dissemination and policy dialogue. To reach this goal, contacts and collaboration have been established with the Chinese Ministry of Construction, administrative bodies in Yunnan Province, and cities like Dalian, that are interested in implementing similar sustainability-oriented projects to that for Kunming.

3 Results of the Kunming Urban Region Development Project

3.1 The Regional Development Component

The most important result in this collaboration in the field of regional planning is achievement of broad acceptance for the development vision. This develop-

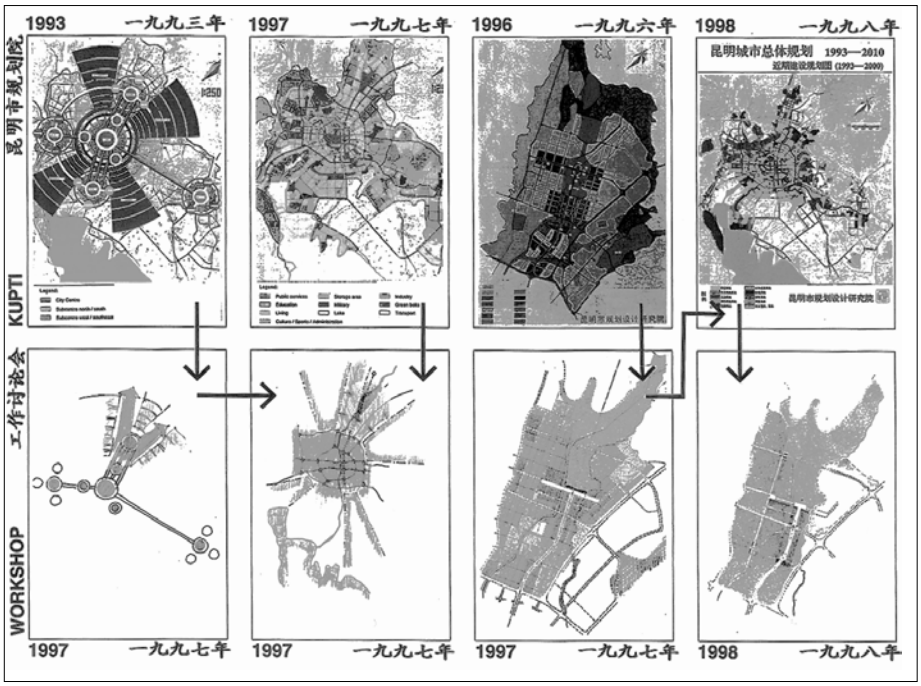

Fig. 3: Development Concept of Kunming North town (source: Stadt Zürich).

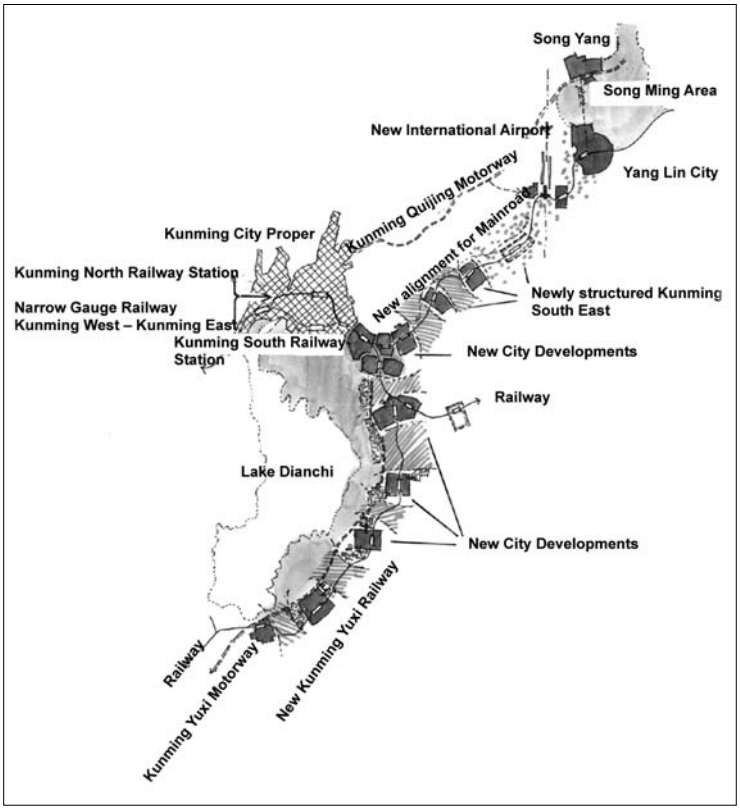

Fig. 4: Kunming–Song Ming development axis (source: Stadt Zürich).

Fig. 5: Subregional guiding plan for Kunming Southeast.

ment vision was devised by simulating alternative settlement patterns using a GIS-based regional model and scenario techniques (trend, which is car based, and vision, which relies strongly on public transportation). The GIS-based analysis clearly showed the economic and ecological advantages of a decentralized network of densely built urban settlements interconnected by an efficient and environmentally-friendly rail-bound transportation system. This strategy has, in effect, been adopted by all decision-making bodies in the Greater Kunming Area (GKA), including the Railway Department. During the meetings, it was impressive to see how the railway department quickly realized its chance to develop a larger and more profitable railway system and how officials immediately cooperated actively: A first axis of the regional rail-bound transport system (Anning-Kunming-Yiliang) is already in an advanced state of planning and should be built before 2005. Efforts to coordinate this transportation infrastructure with the planned settlement structure in an optimal manner are in course, especially in Anning and in Kunming Southeast.

- Suggestions for the reform of the current planning system (implementing comprehensive planning in PRC): As a novelty for the whole of China, GIS-based comprehensive regional, subregional (see fig. 5) and local guiding plans are drawn up to coordinate space-relevant functions and ensure protection of fertile land and other natural assets. Pilot projects illustrate how a surface-covering and sustainability-oriented local planning policy can be implemented. This comprehensive multi-level planning approach got a great deal of attention during the first Sino-Swiss Spatial Planning Comparative Study Seminar in 2001 and will, according to information from the relevant ministry, be considered during the actual elaboration of the new city planning law.
- Implementation of GIS-based comprehensive regional, subregional and local planning: While the topology of the GIS-based comprehensive regional plans has been taken up and integrated into the Lake Dian protection plan, the implementation of the geographic information system on a regional level has not been taken up as yet because management of GIS projects requires a fair amount of know-how and management skills. On the other hand, it is the only way to link relevant data with the topography and integrate both a monitoring and controlling system.
- Monitoring and Controlling Urban Development: The monitoring, controlling and indicator systems have been worked out, discussed, and accepted by technical experts as well as the relevant political leadership. The implementation of the indicator system suggested has

been adopted in the next five-year plan of the Municipal Government of Kunming. Thus, for the time being, main proposals and concepts have been made in this field. Implementation of these is indeed the next challenge.

- Regional Economic Development Strategy: This strategy places the comparative economic strengths of Kunming in a national and international context. By doing so, the city will be able to concentrate its funds on its principal strengths and adjust its spatial development accordingly. Reports illustrating the methodology have been forwarded to the city administration, which must elaborate the strategy itself as this is subject to laws on confidentiality.

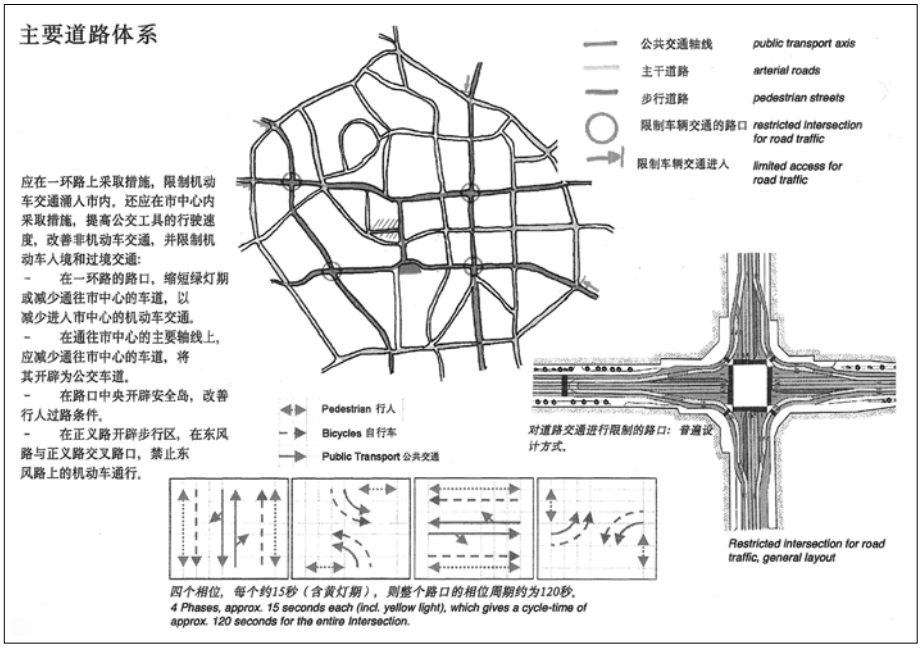

Fig. 6: Traffic management concept in Kunming City Proper (source: Stadt Zürich).

3.2 The Transportation Planning Component

Building and operating the first bus line on a separate lane was a huge success and notice was takten of the project throughout China. Indeed, a survey carried out during the World Horticultural Exhibition in Kunming in 1999 revealed that the demonstration bus lane was the second most popular project among the hundreds of projects carried out for the world exhibition. Moreover, the operational and popular success of the first lane has led to the (independent from the Swiss experts) planning of three additional lanes, one of which is already in construction. Meanwhile, the idea of building a tramway has been replaced by the decision of the Municipal Government of Kunming to first build up a network of bus lines on reserved lanes. This change is based on two main reasons:

- With the same amount of money, many more kilometers of effective public transport lines can be established.
- International experience proves that bus lines on reserved lanes are able to transport similar numbers of passengers to modern trams. The first line on the high-capacity bus network has operated since April 1999, construction work for a second one has been completed, and two more will be built through 2004.

As far as the regional railway system is concerned, the state-run Chinese railway organization is planning a network of Rapid Short-range Passenger Railways, the first of its kind in the People's Republic of China, with new train stations at settlement centers (as recommended by the regional development component). The first part of this suburban train system should be in place by 2005.

Traffic management is successful as well. Besides purely technical suggestions, such as the improvement of crossroad design, the program Priority to Pedestrians, elaborated in collaboration with the City Planning Institute and the City Traffic Police to reduce non-public motorized transport in the city center, received a great deal of support. The Kunming side announced that the implementation of this very progressive program will start in 2003.

3.3 Urban Landscape Planning and Design Component

Among the projects included in the Urban Landscape Planning and Design component, the most successful were the efforts on behalf of historic city protection – leading to the establishment of a historic city preservation office, the protection of the remaining part of the old city and the restoration of four model houses.

Meanwhile, measurement of the results of the other urban design components is more difficult; these include city center planning, the proposals for the north town and the newer projects, as well as those for the satellite cities along the Kunming-Songming and Kunming-Anning axis, and especially the planning of the Eastern shore of Lake Dian.

On the other hand, the actual design process for the new towns on the Kunming-Songming and Kunming-Anning axes and on the Eastern Shore of Lake Dian gave our Chinese counterparts the necessary understanding and input to realize the decentralized but concentrated development pattern proposed. In general, it was encouraging to see them working with what they had learned from previous project phases.

3.4 Dissemination and Networking

Cooperation and discussions with the Ministry of Construction (MoC), Tongji University and officials from many cities such as Beijing, Shanghai, Nanjing, Guangzhou, Dalian and Lanzhou, enabled use of the results achieved in the Kunming-Zurich collaboration project in many other parts of China. In addition, the Third Sino-Swiss Symposium and the First Sino-Swiss Spatial Planning Comparative Study Seminar (Kunming, July

Fig. 7: First Sino-Swiss Spatial Planning Comparative Study Seminar (Kunming, July 2001).

2001) were used as occasions to disseminate the results. There is no doubt that the project influenced understanding of the concept of sustainable urban development and public transportation in China and contributed to the formulation of appropriate laws and regulations by the MoC and by various cities. To prove this influence is difficult, but two examples may illustrate it to some extent:

- The cooperation between ORL-ETH and MoC in the field of spatial planning (visit of Chinese experts at ORL to study the Swiss spatial planning system, and the results of the Sino-Swiss spatial planning seminar) has led to the integration of ideas and concepts from the Swiss spatial planning system into the new Chinese city planning law. The impact on the spatial development of the whole country could be considerable, if the city planning law is gradually converted into a spatial planning law in the proper sense according to government officials.
- The city of Dalian reoriented its transportation policy from planning an underground railway to the more realistic proposal of modernizing its old-fashioned tram system. After three years of discussions, five visits by experts from Zurich to Dalian and two visits by Chinese delegations to Zurich, the construction work for the new tramway system has been completed and 25 modern tramcars are operating.

4 Comparison of the Kunming Project with Other Bilateral or Multilateral Urban Development Projects

4.1 Main Characteristics of Common Bilateral and Multilateral Urban Development Projects

In general, the main characteristics of bilateral and multilateral urban development projects are:

- Usually a project infrastructure needs to be set up (a local office, with staff, expatriate experts, and infrastructure), which is very expensive.
- Usually the project is attached to one administrative body, i.e. the ministry of construction. Whether projects have a chance of being implemented now very much depends on the rank and influence of this body in the governmental administration. The quality of the project also depends strongly on the motivation of this sole governmental body.
- Due to the above organizational structure, the impact of technical collaboration is often reduced, because strategically important findings are or cannot be communicated to the relevant decision-makers.
- In addition, the chosen approaches are often very sectoral: small- and middle-size city development, infrastructure support, or clean air initiatives. It is rare to find these problems addressed with a broad, multidisciplinary approach, which encompasses all aspects of city-development.
- Goals and strategies are usually defined by the donor nation and are sometimes not adapted to the local circumstances; often there are different expectations from donor and receiver. Furthermore, the administrative organization of many receiver nations is often very inefficient and unable to incorporate the proffered know how.
- Project work is mainly done by external consultants. The contribution from local specialists can vary significantly, and with this also the appropriation and ownership of a project. Many times, sophisticated consultancy work is delivered, but because there is no capacity-building on the recipient side, in the end the project is not implemented successfully. As a result, solutions are often not implementable and appropriate to the specific local circumstances.
- Many bilateral and multilateral projects will come to an abrupt end when external funding stops, especially when projects are not really appropriated by the local counterparts.
- When similar projects are carried out in different developing countries, experiences can be learned from and capitalized on.

4.2 Main Characteristics of the Kunming Urban Region Development Project

In contrast, the main characteristics of the Kunming Urban Region Development Project are:

- Under the city partnership, the city government hosts the project partners. Thus, no local project infrastructure needs to be set up.
- The project is directly attached to the city government of Kunming. Thus, all subordinated departmental offices, such as the department of construction, land administration, environment, city planning, traffic organization and police offices, as well as the railway authority, can be directly involved.
- Under the city partnership, the project leaders, who are also the political leaders, discuss the technical projects at the highest political level and have the power to make decisions on implementation. This has a major influence on the ultimate impact of a project.
- The projects to be tackled are usually suggested by local politicians or the city planning administration, and the elaboration of projects is a common enterprise. As a result, most of these projects have found their way to implementation, even if sometimes modified during the decision-making process.
- Discussions on a professional level are made in workshops directly between the responsible leaders of the different institutional bodies in Zurich and Kunming (traffic planners, urban planners, etc.), who exchange experience and also have considerable influence on implementation.
- As a leading technical university was involved, scientific input into practical project work by Kunming and Zurich planning specialists is guaranteed, thus enhancing project work. Thus, a link between the locally based planning work and global issues like environmental protection can be provided.

5 Conclusions

The collaboration with Zurich has demonstrated to Kunming ways to foster urban growth without greater automobile dependence, air pollution and waste of arable land, while maintaining good urban quality. By means of its regional multidisciplinary planning approach, its investments into a strong local and regional public transport sys-

tem, and its efforts to promote environmental protection, Kunming has the opportunity becoming a model city for future urban development in China, a model which is most urgently needed. This would not have been possible without the input of the sister city Zurich.

The current achievements rely very heavily on the relationship of trust between experts and public officials from the twinned cities, as well as on study trips organized for decision-makers to European cities that have modern bus and tramway operations, advanced transport organization, and extensive pedestrian zones, and which follow a policy of coordinated development of transportation and settlement patterns.

Due to shared experiences on the same city level, collaboration with specialists on both sides has furthermore proved to be a very successful approach. It also showed that the usual negative factors of foreign planning support, such as missing field experience and the lack of implementation, as well as the use of unadapted planning policies and tools, have never been an issue.

These negative factors did not become issues because responsibility for implementation was automatically assumed by the locally rooted Kunming authorities. As the collaboration was organized in workshops, it required comparatively little input in terms of money and time from the Zurich side. Despite the small input, the results are impressive and generally appreciated by specialists worldwide. The value of the collaboration is very well characterized by statements by Professor Peter Newman of Murdoch University in a letter to the City Mayor of Zurich: "It did not surprise me to hear that the kind of values which drove you to create such a fine city [Zurich] would now see that there is a responsibility to extend this to cities that are struggling with similar issues in other less wealthy parts of the world. […] The importance of the project that the City of Zurich has initiated in Kunming is even more important I feel than the example you have set in Europe. The world is desperately needing examples of cities that are showing how a sustainable future can be created without excessive car dependence. […] Although national aid projects are important, there are not nearly enough of these city-to-city partnerships, which can offer so much due to the shared experience of people who have to work on a city level."

Notes

[1] For example in the book *Sustainability and Cities* by Peter Newman and Jeffrey Kenworthy, Island Press, Washington DC, USA, 1999.

[2] Outline of sustainability-oriented planning policies:
– Promoting Kunming as the main future center of population and economic activity in Yunnan Province (and relieving rural areas of surplus population).
– Actively preparing the Greater Kunming Area for its future role as an agglomeration of regional size (planning and coordinating settlement and transportation patterns; promoting a decentralized concentration of urban settlements inside the urban region, leaving space for nature; promoting mass transportation and unmotorized transportation; promoting mixed uses around city-centers).
– Promote clustering of same type industries and services at best-adapted locations, and hinder further spreading of polluting low-tech industries in remote rural areas.
– Protect historic sites and city centers and original functions, by keeping the original population.

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Lin Wei, Tang Chong

Theory and Practice of Bus Lane Operation in Kunming

Taking into consideration its present urban economic standards and population scale, the City of Kunming adopted a development strategy which gives priority to people's needs and public transit, pays enough attention to the environment, and supports Kunming's sustainable development. In accordance with the public-transit-first policy, Kunming successfully rolled out China's first center-lane bus lane during the 1999 World Horticultural Exposition. Recent surveys show that the bus lane is outstanding with regard to both environmental protection and passenger transport efficiency. Kunming's long-term goal is to shift the burden of public transit from buses to rail lines. Besides reporting on the implementation phase and impacts of Kunming's first center-lane bus lane, an overview of existing challenges and proposed improvements is presented.

This paper was first presented at the Third Sino-Swiss Symposium on Sustainable Urban Development and Public Transportation Planning, Kunming, October 2001.

1 Survey

During the past twenty years and especially since the 1990's, Kunming's society and economy have developed rapidly and its urban construction continues to improve. In spite of the city's remarkable achievements, restraints imposed on urban sustainable development by population, resource and environment issues are getting more and more obvious. The urban infrastructure, especially the urban traffic system, can hardly bear the growing burden. Within the last few years, urban traffic volume has increased incredibly and citizens now suffer from difficulties when traveling on foot or by bicycle, car, or bus. These problems need to be solved immediately. In addition, traffic jams are leading to noise and environmental pollution. In the new century, Kunming's ability to develop a modern and highly efficient urban traffic system will dictate whether or not the city can accomplish sustainable and healthy urban social and economic development.

In order to thoroughly solve Kunming's urban traffic problems, since 1993, the city has cooperated on matters of technology with its international partner city, Zurich, Switzerland. Using advanced international theories from Swiss experts and incorporating the successful experience of urban traffic planners from large Chinese cities, Kunming established its own urban traffic development strategy, which "gives priority to people's needs and public transit" and created a blueprint for its modern public transit system, with a focus on rail traffic.

Considering its present urban economic standards and population scale, Kunming adopted a development strategy in which urban public transit will be constructed phase by phase. In the immediate phase, the traditional bus system will be modernized and further developed by instituting a public-transit-first policy. In addition, a large-capacity transit-only lane will be opened, which will improve Kunming's urban traffic conditions immediately. Kunming's medium and long-term planning goal is to shift the burden of public transit from buses to rail lines.

In accordance with this concept, Kunming successfully rolled-out China's first center-lane bus lane during the 1999 World Horticultural Exposition. On the basis of this, Kunming opted for a grid-shaped buslane network, which is to be built in the near future. Construction of such a network aims to upgrade traveling efficiency, turning downtown Kunming into a "paradise" for bus users because of the efficiency of its public transit system.

2 Principle for Design of Kunming's Bus Lane

In large cities with growing populations and high construction density, the only way to solve urban traffic problems is to implement a public-transit-first strategy. Developing large-scale public transit is the common view of urban traffic planners from all of China's large cities. Under China's specific urban traffic circumstances, the critical issue facing Chinese cities with over one million people is how to implement a "public-transit-first" strategy in terms of technology and how to modernize the traditional bus system. Experts on traffic from Kunming and Zurich have cooperated to implement the "Model Bus Lane Project of Kunming," which strives to reflect the following ideas and principles:

- *Transportation efficiency:* The bus lane ought to be highly efficient, this being guaranteed by strict special-use rights, minimal transverse disturbance, the quick running of buses, and shorter delays at stops and intersections.
- *Service standard:* The concept of "giving priority to people's needs" should be fully represented, including good riding and waiting environments, continuity and passenger comfort during the entire traffic process, accurate information for passengers, a convenient and fair ticketing system, all with respect and consideration for the passengers.
- *Network system:* The entire public transit network's service function must be upgraded. This includes making a good space structure and grading structure, as well as forming a convenient and efficient passenger-transfer system between different bus routes (covering mainly transfer distance and expenses).
- *Environmental protection:* Improving environmental quality is an important target of the project, which has a bearing on two aspects. The reduction of the noise level on Kunming's roads and the decrease of tail gas pollution will come about as the city implements the public-transit-first policy and people start to use other vehicles to move about the city. Secondly, the public transit vehicles' performance in meeting environmental protection standards should also be considered.

3 Major Design Characteristics of Kunming's Bus Lane

Kunming's bus lane has not only adopted the latest foreign ideas in public transit design, but has also taken the specific conditions of China's cities into

consideration. The construction and use of Kunming's buslane challenged traditional China's public transit development methods in many ways and survived the test of time. The successful operation of the bus lane is an important symbol of fundamental changes in Kunming's urban traffic development orientation. We hope that Kunming's use of the bus lane can provide some valuable experience to other sister cities, thereby improving their public transit. The following is a brief summary of the major design characteristics of Kunming's bus lane.

3.1 Route of the Bus Lane

Kunming's bus lane runs along the most important south-to-north artery (Beijing Road) artery network, which includes three East-West roads and four North-South roads. With a total length of five kilometers, the Beijing Road lane runs through the entire central area of the city, which is home to large numbers of government, commercial, and financial buildings on both sides. At opposite ends of the lane are the major passenger railway station of the city and the freight railway station. The road is the traditional axial road, which before the bus lane was added, used to be a very inefficient transportation route due to traffic jams. During rush hours, the average speed of private vehicles along the road was only about 12 km/h and that of buses was lower than 10 km/h. Redistribution of Beijing Road's traffic according to the principle of "public transit first" and establishment of the bus lane turned the road into a highly efficient passenger transportation thoroughfare and improved the prosperity of the facilities along the road.

3.2 Bus Lane

Establishing bus lanes is the most effective way to improve urban public transit. On average, the one-way transport capacity of a bus lane is about 6,000 people per hour. By adopting special measures, the figure can reach 15,000 to 20,000 persons per hour, equivalent to between five to 20 ordinary mobile vehicle lanes. In the bus lanes, the buses can reach 16 to 22 km/h or more.

Many cities in China have opened bus lanes, but most of them are built on the outside lane, which is not optimal because the buses are seriously hindered by exiting and entering traffic and vehicles parked in the bus lane. In central urban areas suffering from very congested traffic and too many intersections, locating bus lanes on the innermost lane offers buses the best running conditions and allows them to reach the large traffic-carrying capacity of a light railway. This is the ideal concept for a bus lane. In order to fully represent the idea of "public transit first" and upgrade public transit transport efficiency, Kunming has adopted the inside-type bus lane as described.

3.3 Stop Location along the Bus Lane

The location of the bus stops has a great impact on the bus route's service scope and standard. Taking the walking time of passengers before and after boarding the bus into consideration, we find that a short distance between two stops can shorten the total travel time. Therefore, in Kunming's central urban area, characterized by a dense population and concentrated housing units, the buses stop at frequent intervals. There are seven pairs of stops along the bus lane currently operating in Kunming, with an average distance of 541 meters between each stop.

The most important factor in deciding the location of bus stops was facilitation of passenger arrival, departure, and transfer. At the intersection of more than two routes, each route's stops should be close to each other, shortening the walking distance for transferring between buses as much as possible. Obviously, intersections are the most convenient rendezvous for people and buses from all directions making them the best choice for location of bus stops. If the platform is arranged at the exit of the intersection, passengers can easily find their way out and the arrangement of the intersection can be relatively easy. From this point of view, one of the basic characteristics of modern public transit systems are the bus stops set up at intersections. Only with these can the efficiency of the public transit network really be upgraded.

Fig. 1: Beijing Road, Kunming: The first bus lane, located on the middle lane.

3.4 Platform Type for Bus Lane

Adhering to the design concept of "giving priority to people's needs," modern public transit pays thorough attention to passenger comfort and safety. To spare passengers long waiting times, the capacity of public transit should be enlarged, necessitating platforms long enough for a quick and convenient flow of passengers. In addition, since the platform stands between lanes for private vehicles, the waiting area should be large enough to guarantee safety. Therefore, the platforms along the bus lane throughout Kunming are designed to be 65 meters long and 3.5 meters wide. These will also serve as the platforms for the future light railway.

4 Result of the Implementation of Kunming's Bus Lane

The buslane in Kunming opened for traffic on April 20, 1999. The lane has greatly improved the service standard of Kunming's public transit, becoming a main thoroughfare during the World Horticultural Exposition. Meeting the design goal of smooth and highly efficient transportation, the lane has been well received by people in the transportation industry and from all walks of society.

We studied traffic flow (of private vehicles) at typical intersections and under normal bus operating conditions along the lane in order to demonstrate the re-

	Before opening the bus lane	After opening the bus lane		Increase and reduction
		(after 2 months)	(after 2 years)	(after 2 years)
Car traffic flow	1,840 per hour	1,326 per hour	1,611 per hour	–12.4%
Standard car traffic flow*	2,150 cars/hour	1,740 cars/hour	2,039 per hour	– 5.0%
Passenger volume:				
Non public transp. vehic.	4,233 people/h	3,051 people/h	3,921 people/h	– 7.4%
Bus	9,936 people/h	11,256 people/h	12,000 people/h	+21.0%
Total**	14,169 people/h	14,307 people/h	15,921 people/h	+12.4%
Actual transport capacity of buses	11,040 people/h	16,000 people/h	16,000 people/h	+45.0%
Occupancy rate of buses***	About 90%	About 70%	About 75%	–17.0%
Per capita delay at stops	68 seconds	46.2 seconds	47.9 seconds	–29.6%
Average speed of buses	9.6 km/h	15.2 km/h	15.0 km/h	+56.3%
Average boarding/desc. time	56 seconds	23 seconds	28 seconds	–50.0%

* Cars, buses and trucks changed into standard car units

** All motorized modes

*** Reduction means increase in comfort

Table 1: Inspection result of traffic flow at typical intersections.

sults of this project. The data shows that the bus lane is outstanding with regard to both environmental protection and passenger transport efficiency.

4.1 Operational Status of Public Transit

The average speed of public transit in the downtown area before: 9.6 km/h; after: 15.2 km/h; an increase of 68%.

The average boarding and discending time at stops in the central area before: 56 seconds; after: 23 seconds; an improvement of 59%.

4.2 Citizens' Attitude

In order to measure the response of Kunming's citizens to the bus lane, we carried out two surverys. One was conducted after the project had been put into operation (1999), while the other was held before the construction of the second bus lane (2001). In 1999, the total satisfaction rate of citizens toward the project was 79%. In 2001, the total satisfaction rate was over 96% (active support: 56.3%; support: 39.9%; indifferent: 3.0%; objection: 0.8%). The surveys demonstrate that the "public-transit-first" strategy in Kunming has not only improved Kunming's urban traffic conditions, but also benefited the majority of the citizens and received praise from the public.

4.3 Comprehensive Evaluation

Implementation of the project has resulted in more reasonable and just distribution of sparse urban traffic space. Transport efficiency and the service standard of public transit have been upgraded. At the same time, when the flow of people and the city's vigor are strengthened, the private vehicle traffic flow, exhaust pollution, and noise pollution are reduced, and the urban landscape is improved. Our success with the "public-transit-first" idea provides a solution to society and government for dealing with traffic and environmental problems. The project was a major turning point for urban traffic development in Kunming, widely acknowledged by domestic and foreign academic circles on urban traffic. In addition, the public transit service has cared for passenger comfort and safeguarded the transit rights of citizens, especially those with low income. Public transit has been accepted by people from more and more social circles, which has promoted intimacy and exchange among people from various social groups.

5 Problems with Kunming's Bus Lane and Countermeasures

5.1 Illogical Arrangement of Intersections

The intersections of Kunming's major arteries have always been the place where all kinds of traffic modes compete for time and space. In addition, the intersections with the most concentrated traffic counterflows are also on the main arteries. The special use of public transit rights and the relatively wide platform at intersections for the inside-type bus lane have seriously narrowed traffic space for other types of transportation. Narrow and short exit and entry lanes at intersections lead to two major problems. First, private vehicles and bicycles seriously hinder each other at the exit and entry lanes. The traffic there is disorganized, with low passing efficiency and serious hidden hazards. Second, the length of the vehicle queue exceeds that of the widened section, resulting in a blockage between vehicles going in all directions. There are three ways to improve this situation. First, the width of intersection entry lanes for mobile vehicles can be reduced appropriately, since the speed of the vehicles at intersections is relatively slow. Secondly, the width of the platform at intersections can be reduced to 2.5 or 3.0 meters from the original 3.5 meters according to passenger flow. Finally, the length of the widened section at intersections should be rationally determined according to the length of the queue.

5.2 Unsatisfactory Arrangement of Platforms at Some of the Intersections

Since there are no isolation barriers between the sidewalk and the platforms at some intersections, some passengers directly cross over several private vehicle lanes in order to enter and exit bus stops. The situation can easily lead to traffic disruption, or worse, accidents. We plan to set up the necessary traffic

facilities needed to restrain incorrect passenger traffic activities and to guide them to pedestrian walkways at the intersections.

5.3 Serious Cross Traffic Interference in Some of the Sections

Since some of the sections along the buslane have not been equipped with in-lane isolation barriers according to the design, there can be serious consequences; these include U-turns by private vehicles, left turns by vehicles to and from buildings along the lane crossing lanes for straight-running traffic, and crossing by pedestrians and bicycles. The situation is getting more serious, especially during the rush hour, greatly affecting the efficiency of buses along the bus lane. The in-lane isolation barrier and even the movable barrier at some sections need to be extended. Moreover, pedestrian signal lights should be installed to regulate pedestrians crossing the road.

5.4 Excessively Long Signal Cycle at Intersections

Since public transit was granted special road-use rights, the signal delay at intersections has become a major factor affecting operational efficiency. Currently, the traffic signal control mechanism in Kunming is still arranged for car traffic and one signal cycle during the rush hour can be as long as 200 seconds. The long signal cycle has increased delays for buses at intersections as well as the waiting period passengers entering and exiting the platforms. In line with experience gained in other countries' and Kunming's reality, we are going to shorten the signal cycle to increase the chance of buses having green lights at intersections. In this way, waiting at signals can be reduced and buses' operational efficiency can be upgraded.

5.5 Unsatisfactory Selection of the Type of Buses

The type of buses selected has great impact on public transit's operational efficiency and service standard. The basic characteristics of modern public transit vehicles include comfort, high occupancy rates, convenience for boarding and disembarking, and environmental friendliness. The current economic position of the municipality of Kunming is not strong enough to allow the purchase of a large quantity of high quality buses. Meanwhile, the domestic bus market is not able to provide the ideal types of buses. Apart from inadequate overall performance, Kunming's current buses are criticized for their small doors and their extremely narrow passageways for passengers entering the buses. This seriously affects passenger boarding, disembarking, and flow. In the future, Kunming will purchase a new type of large-volume, large-door, and low-floor bus with information displays and good environmental protection performance.

Fig. 2: Renmin Road, Kunming: The second bus lane with platforms at intersections.

5.6 Excessive Allocation of Buses' Transport Capacity

Since the bus lane system was opened, the public transit operation department has allocated many routes to run along it. There are over 20 bus routes that wholly or partially cover the lane. The route network is not meticulously designed and arranged. A large number of "rubbish routes" have been designed to cover the bus lane without benefit to the overall service standard. At the same time, the excess transport capacity usually means that the number of arriving vehicles exceeding the volume of the platform during peak periods of operation. The buses have to wait at intersections for the next signal cycle, which reduces the efficiency of the bus lane. Measures taken to solve this problem will involve optimizing the route network structure and rational allocation of bus routes for the lane. In principle, the bus lane should be reserved for operation of those bus routes with large transport capacity and high service standards.

5.7 Single Passageway Restricting Efficiency

The single bus lane can only upgrade the efficiency of the bus routes along the lane.

Routes that partially cover and intersect with (transfer to) the bus lane can only be partially improved or benefited. Therefore, the function and service scope of the lanes is limited. The practice has demonstrated that in order to effectively improve the public transit service standard of a certain area, both the efficiency and service standard of the public transit system need to be upgraded as a whole. From the public transit user's point of the view, starting and finishing points for journeys are widely scattered. Unless the entire network is highly efficient, large numbers of potential passengers will not really be attracted to public transit. That is why although the public transit capacity of Kunming's bus lane increased by nearly 50%, the number of passengers increased by only 13%. We therefore need to construct a bus-only road network of the proper density as quickly as possible as well as need to optimize the public transit network arrangement and take effective measures to eliminate or reduce obstacles to transfer from route to route.

Based on the success of the first bus lane, taking the central urban area as the core, Kunming will construct a grid style public transit-only road network in the near future. The second bus lane is in the construction preparation phase; when completed a +-shaped preliminary bus-only road network will be formed together with the existing bus lane along Beijing Road. The design for No. 2 bus lane has taken experience and lessons from the first one into consideration leading to improvements in lane distribution and platform design.

6 Supporting Measures for Kunming's Bus Lane

6.1 Establishing and Publicizing Urban Traffic Policies

We are establishing Kunming's urban traffic development policy that "gives priority to people's needs and public transit, pays enough attention to the environment, and supports Kunming's sustainable development" as quickly as possible. To promote the bus lane net-

work we are publicizing and implementing the policy, winning understanding and support from all walks of society, guaranteeing smooth implementation and efficient operation.

6.2 Restricting Car Transportation

Controlling parking lot areas downtown within an appropriate scale, encouraging construction of public parking facilities, and applying a parking system are important means to control car traffic demand. Further ways to control private car use are park-and-ride and bike-and-ride traveling experiments around the large-scale residential areas on the outskirts of the city, rationally guiding the interaction of traffic modes, and reducing traffic pressure in the central urban area. In addition, we encourage pedestrian traffic and are creating good conditions for it, while opening more and better pedestrian zones in business centers with developed public transit.

6.3 Optimizing the Road Network Structure

- Carrying out optimization and integration over the functional structure of the urban road network.
- Giving full play to the functioning of current traffic resources and upgrading the overall passing ability of the road network.
- Focusing on a scientific and accurate orientation of road functions.
- Straightening out relationships of the intersections and giving full play to traffic functions of the sub-arteries and bypass system (opening one-way streets, setting up curb parking lots, establishing a bicycle-only system and a pedestrian zone).

Fig. 3: Intersection with two bus lanes and four platforms.

6.4 Giving Priority to Public Transit Signals

We are studying and implementing technological and management measures to give priority to public transit vehicles at intersections in coordination with the formation of the bus-only road network. Based on technological considerations, the work is divided into three phases. First, the signal cycle is to be shortened to reduce the average waiting time of the buses. Second, the signal-matching plan for minimizing dual waiting time of buses is to be compiled and implemented in accordance with a regular public transit-dispatching plan. Third, we shall study the possibility of giving green lights to buses as they approach intersections.

6.5 Modernizing the Operation Schedule

We will adopt new technologies to gradually construct a GPS-based public transit operation schedule center or other electronic positioning systems, with the objective of improving public transit's operational efficiency and service standards.

6.6 Public Transit Ticket System and Reform of Public Transit Market

We will speed up the ticketing-system reform and import an IC card ticket system. The charging mechanism should aim to increase transfer efficiency and represent the principle of fair pricing. We will also stipulate policies and measures on public transit market management; break monopolistic operation and adopt market competition mechanisms in accordance with the reform of state-owned enterprises; promote the service standard of public transit and minimize the financial burden of the government.

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Old Town Preservation in Kunming

Within the framework of the city partnership between Zurich and Kunming, a group of Swiss experts in historic preservation started to support Kunming's preservations efforts in 1996. In the initial phase, the intensive collaboration between Swiss and Chinese colleagues focused on evaluating historical building substance in the protected areas of Kunming. In 1997, the "Wen Ming Protection Area" was established. Soon afterwards, a pilot project involving the complete renovation of a historic house was initiated. In the meantime, the Kunming Street Block and Building Protection Office has been established. It plans to extend protection efforts to the entire city in 2003 and 2004.

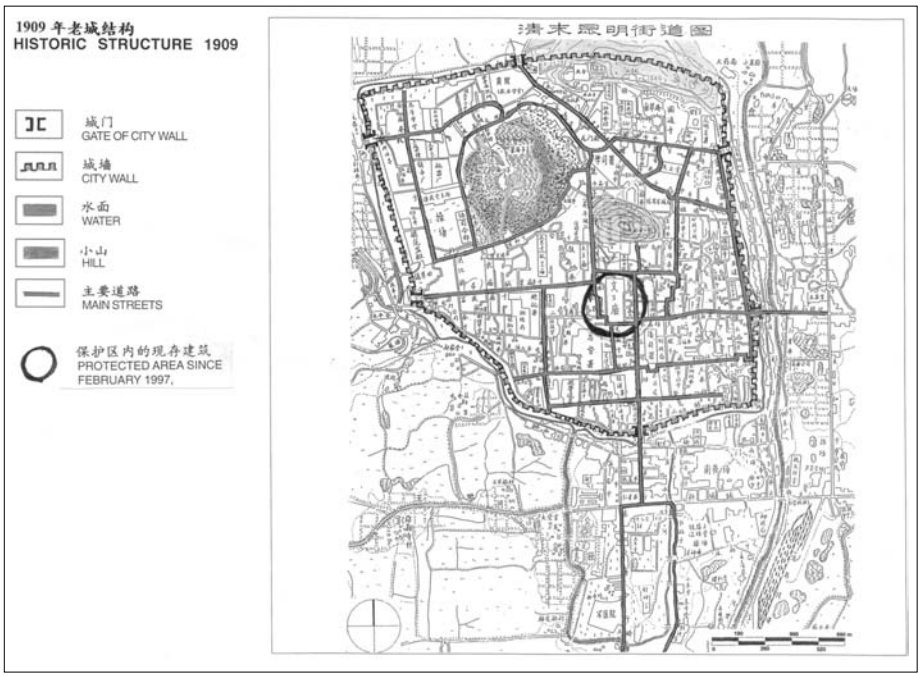

Fig. 1: Map of the City of Kunming in 1909.

1 Historical Kunming Endangered

Kunming, the capital of Yunnan Province in southwestern China, is nicknamed "City of Spring" because the trees and plants proliferating throughout the city are covered with rich foliage all year round. In ancient times, it was an important gateway to the Silk Road. The city was founded during the Tang Dynasty (618 to 907 A.D.) and the oldest city walls date from the 8th century. Even at the beginning of the 1990's, travel guides described as essential elements of this city small-scale, one to two-storey districts characterized by wooden and clay-brick houses with sloping tiled roofs and richly carved facades. These houses were built in the 19th and early 20th centuries using the construction principles, materials, and form language of a centuries-old building tradition.

Today, Kunming has around two million inhabitants living on approximately eighty km^2. Yunnan Province, which covers an area almost ten times larger than Switzerland, has over forty million inhabitants, and Kunming is the only large city within a radius of hundreds of kilometers. As a result, the city is experiencing immense population growth, and in addition it is estimated that around 600,000 to 800,000 migrant workers from northern China as well as neighboring Vietnam, Burma and Laos live here.

Kunming, like every other Chinese metropolis in the past decade, experienced out enormous, rapid building developments causing sweeping urban change. Skyscrapers shot up like mushrooms, multiple-lane transportation arteries were built through narrow city districts. The extensive historical city center quickly disappeared and the old city walls and gates simply vanished. However, both Ming Dynasty (1368 to 1644 A.D.) pagodas, which were destroyed in the 19th century, were rebuilt and a few temple complexes were spared. The traditional Chinese city structure, with its special orientation and ordering principles, is barely legible now. The former government city Kunming has almost completed the transition to a modern service center. The quick tempo, with

Fig. 2 to 4: In the late 1990s, a trend to demolition prevailed in the historical center of Kunming.

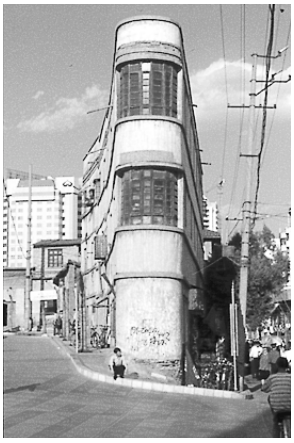

Fig. 5, 6: Buildings in the city center of Kunming which are interesting from a typological or stylistic point of view.

which old, small wooden houses are replaced with new, up to 100 meter tall glass and steel skyscrapers is breathtaking for Europeans, and the pace even increased because of the International Garden Exposition (Expo 99), with 15 million visitors expected. A few remnants of the historical city center have survived, although the buildings were and remain in a critical condition: not only do they lack modern sanitary infrastructure, but the entire substance of buildings – from flooring, structural members and walls to the weed-overgrown tiled roofs – would need thorough renovation.

2 Wen Ming Protection Area

Parallel to the trend to demolition prevailing the end of the 1990s, Kunming's politicians and planning department began the slow process of reconsidering what was happening. Terms like sustainability, identity, and historical consciousness, were used more and more by younger city planners. These people received support from Swiss specialists, because of the city partnership established in 1982 between Kunming and Zurich. Due in part to efforts by representatives from Zurich within the framework of the project "City Development Kunming – Public Transportation Masterplan," protection of the historical city center became an important theme in 1996. A group of Swiss specialists, under the leadership of planner and architect Carl Fingerhuth, supported all efforts in Kunming to retain the structures and buildings of the old city which were more important and necessary for residents, for a common city identity and for cultivating Western and Chinese tourism than steel and glass skyscrapers that look exactly like those in Singapore, Bangkok or Frankfurt.

Unfortunately, the first efforts at preservation and proposals for legal protection for the southern parts of the historical city center near the two Ming pagodas were ignored by the decision-makers. There, the old, narrow north-south axis, lined with trees and decorative two-story wooden houses, had to make way for a faceless highway. Instead of a winding district of historical small houses between the two pagodas, there is an immense boulevard with pseudo-historical palaces and a massive, fortified city gate where before there was none.

Fig. 7, 8: Buildings in the Wen Ming Protection Area, surrounded by newly built skyscrapers.

However, the first preservation concepts for the northern city center near the romantic Flower-Bird Market as well as the proposal for a protection perimeter and for an inventory, albeit minimal, of the protected buildings, were met with success. This moved Kunming officials to establish the "Wen Ming Protection Area" in February 1997, a cohesive, almost 40,000 m^2 area where demolition of existing buildings and erection of new buildings was prohibited. To the author's knowledge, Kunming is one of the few cities in China that is prepared to use such zoning measures, not only for individual historical monuments, for example temple complexes, but also for larger continuous areas of houses and commercial buildings.

Kunming city officials have still not declared how they plan to enforce these protective measures. Although buildings were not demolished in the "Wen Ming Protection Area," they were neither renovated nor restored, despite the fact that skilled workers were available that could have repaired the old walls and woodwork – everything from a door to a handrail. The reasons are multi-layered and include the lack of investors and necessary funds, insufficient political willpower, and opposition from private property owners.

3 Adequate Inventory Methods

In the spring of 1998, also within the framework of the Zurich-Kunming City Partnership, Zurich's Department of Historical Preservation offered its services and extensive experience. Intensive collaboration between Swiss and Chinese colleagues began that focused in a first phase on inventoring and evaluating the historical building substance in the protected areas of Kunming. With the expertise of building researcher Margrit Christensen, the Swiss team developed a simple, easy-to-learn and comprehensible inventory method. A precise and systematic record of existing elements is a prerequisite for the best, most objective evaluation of an object, to determine to what extent protective measures need to be taken and for regulation of

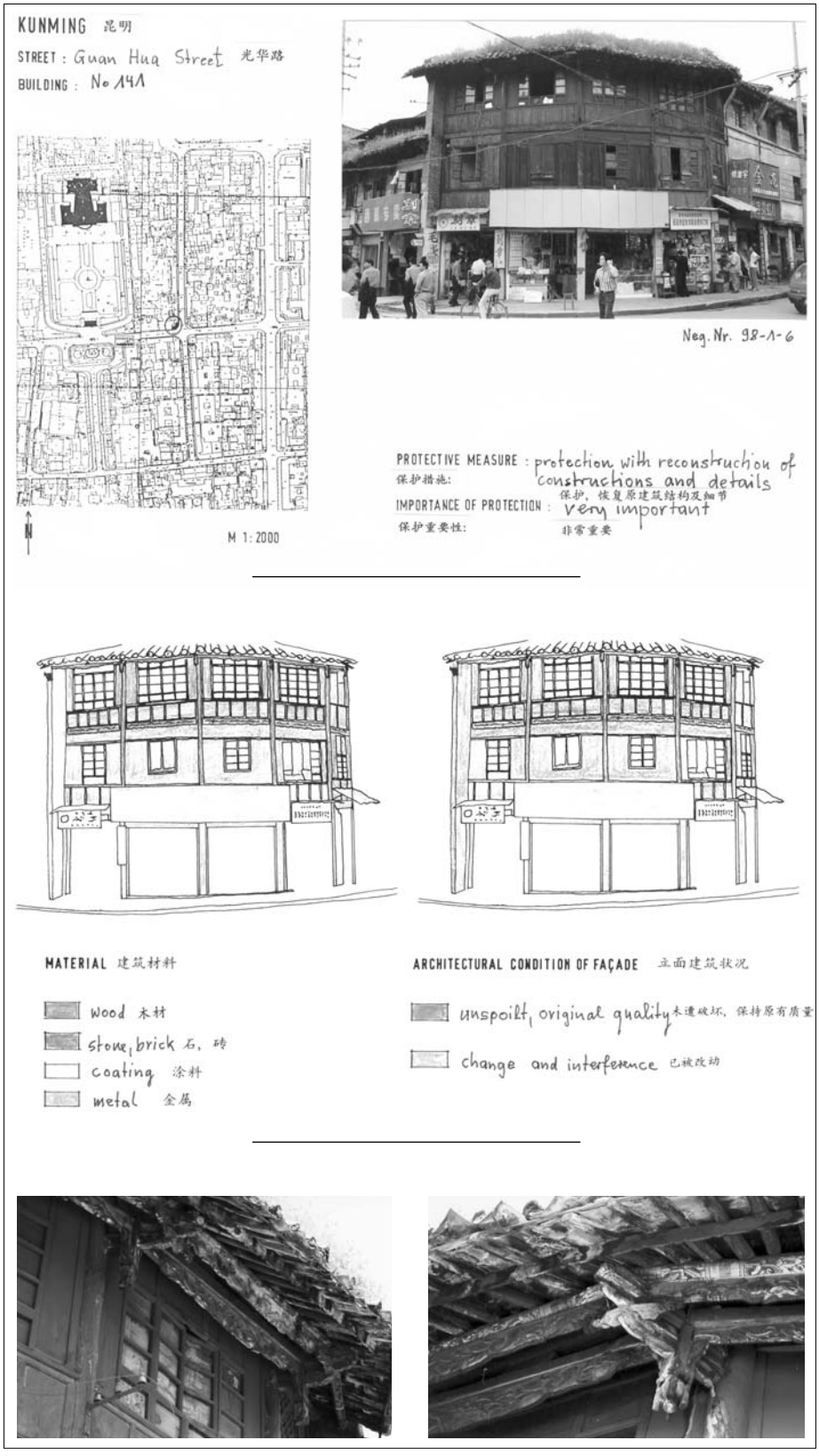

Fig. 9: Inventory of the historical building substance in the protected areas of Kunming.

individual objects and groups of buildings, including how they are used. Above and beyond the framework of this know how transfer, precise observation, recording and analysis techniques were needed, in order to support Chinese efforts to understand and assess the value of their cultural buildings.

Inventory of Street Facades

- Sketches of the facade, drawn to scale and noting materials, present state condition and any changes or interventions that have damaged its original appearance.
- Photographic documentation of the facade, including construction details and any decorative painting or carving work.

Inventory of Street Blocks

- A map of both old and new buildings, as well as buildings that are determined to be incongruent or disturbing.
- Drawings and photographs of characteristic roof landscapes.
- An inventory of the circulation system (streets, alleys and squares) using cartography and photography.
- The development of a typology of existing historical buildings, i.e. courtyard houses in their many different variations.

Inventory of Individual Buildings

- Measurement of the building and best-possible documentation of the facades, plans and sections.
- Description and documentation of the condition of and furnishings in individual rooms.

The Swiss team began making an inventory of the "Weng Ming Protection Area" in the summer of 1998, with the help of a local planner. This led to the first evaluations of the houses. In particular an inventory was made of the most significant facades in the narrow alleys as daily markets are held in the streets and a scenic background helps highlight tourist attractions. This aspect was of first priority to Kunming officials, even more since protecting historic building substance has little tradition in China. Above all, determining the form that subsequent new buildings on a particular site may take, will become more important in China, even though they are constructed from more modern building materials, for example concrete instead of wood.

4 Pilot Project Jin Lan Tea House

Soon afterwards, the Kunming officials suggested that a pilot project be initiated, where colleagues from Zurich would accompany the entire process of completely renovating a historic house – from inventory to the last brushstroke – in an exemplary manner. Renovation of

Fig. 10: The pilot project Jin Laan Tea House has been carefully restored.

a traditional wooden two-storey courtyard house provided by the city, should become a cornerstone for the restoration of the entire historic city center – an example for private investors and a prestigious showpiece for international collaboration in the area of cultural asset maintenance. This project turned out very differently and yet a lot better than we had ever hoped. The city of Kunming bought a house and estimated the renovation costs. Then, exact drawings of the existing house were made, rooms were documented and photographs taken, and an analysis made of various future uses for the house. However, the private owner, who had originally bought the house as a demolition object, was faster. By the time of our next visit to Kunming, the house had already been repaired, carefully restored and furnished as a tea house – a substance-friendly use for the building. In the meantime, the Jin Lan Tea House has been put on the list of the "Unesco Asia-Pacific Heritage Awards for Cultural Heritage."

5 Professional Exchange and Know How Transfer as the Foundation for an Office for Historic Preservation in Kunming

In the summer of 2000, in Kunming's city planning department a special historic preservation office was founded – the "Kunming Historical Street Block and Building Protection Office" – that now officially takes care of protecting and overseeing all forms of renovation in the historic city center. The new office presented itself to the public in a festive manner by means of poster campaign and by distributing informative pamphlets that contained guidelines for dealing with historic buildings; the opening was well covered by the press. The establishment of this office became the key to the first real successes in the area of historical city preservation in Kunming.

The founding of the Historical Street Block and Building Protection Office was the result of intensive exchanges between representatives from Kunming and Zurich. Two Kunming preservation specialists visited Zurich's Department of Historic Preservation in September 1999 and gathered information on making inventories, archiving and practical preservation, as well as management processes, financial systems and legislation from both city and cantonal representatives. In addition, they visited buildings being renovated as well as already restored buildings, and took part in workshops and commission meetings, where questions regarding the protective merits of individual buildings were discussed.

In October 1999, in cooperation with Zurich's Department of Historic Preservation, a six-day inventory seminar was held in Kunming. In addition to planners and architects from both cities, coworkers from Kunming Museum (who are involved with antiquities in general) and four students from the architecture department of Yunnan Polytechnical University took part. In line with the inventory methods developed in 1998, we introduced the participants to the methods used for recording, documentation and evaluation of the substance of historic buildings. Further, we dealt with use analyses for houses and groups of houses, how to document damage in-

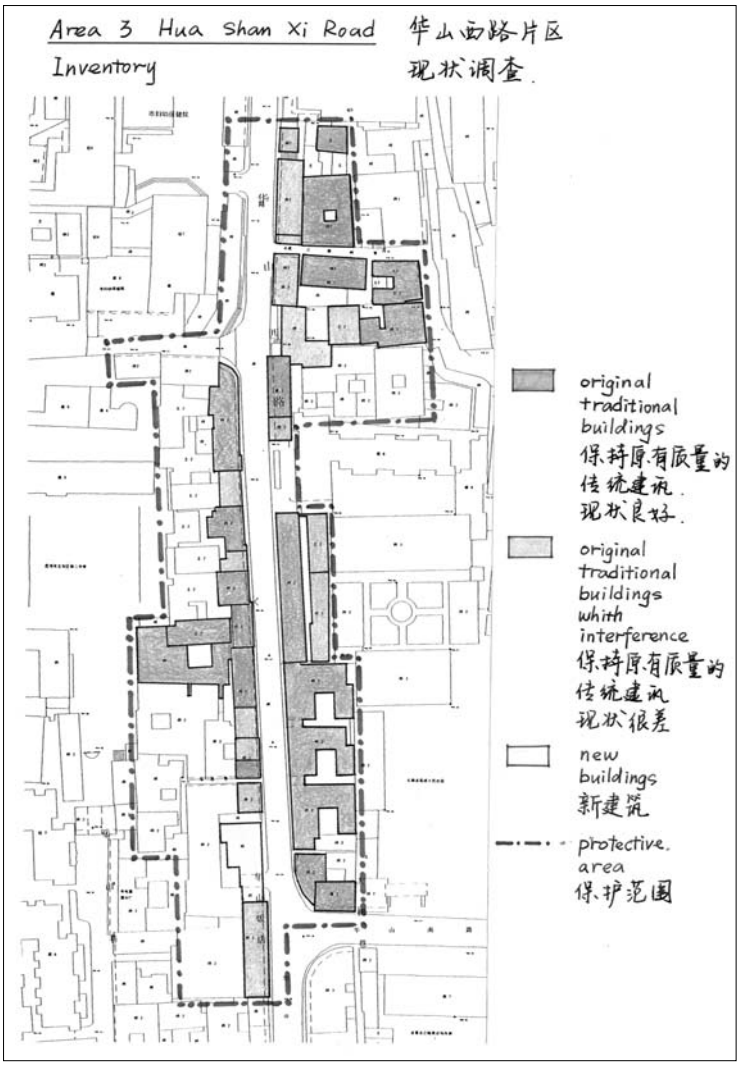

Fig. 11: The Kunming Historical Street Block and Building Protection Office made public its plan to extend efforts to the entire rest of the city.

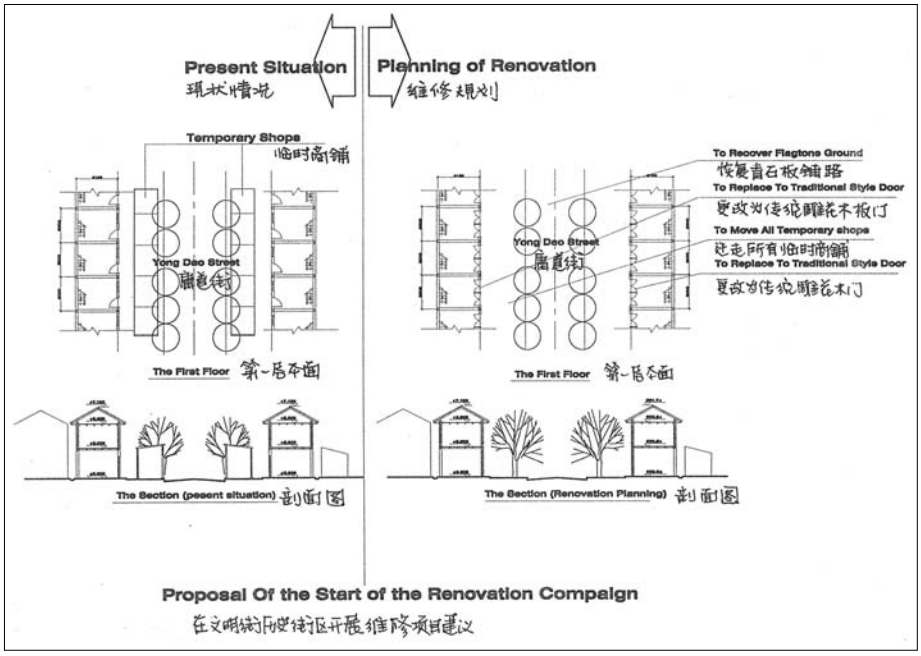

Fig. 12: Proposal of the renovation project Flower-Bird-Market.

side houses, how to determine renovation grades and how to note owner and tenant relationships of individual houses, both in the classroom as well as in the field. In addition, we elaborated the housing block analysis technique (mapping historic courtyards with photo documentation of the individual courtyards). Simultaneously, we developed a sheet for recording the most important and relevant information for each house to serve as a cover sheet for every complete documentation. The methods and techniques tested then as well as the information sheets are being used in preservation work in Kunming today by city officials as well as by architects making inventories on their behalf. Another result of the seminar was that experts in Zurich and Kunming developed a close collaborative relationship with similar lines of thought.

6 Visions and reality

The change of attitude of Kunming's government from ideology of a "tabula rasa" city development to one maintaining the worth of remaining historic buildings and cultural buildings is increasingly strong. Our long and continuous collaboration always seems to bear more fruit. Today, no one speaks of demolishing houses in the "Wen Ming Protection Area" anymore. All of the houses are inventoried, measured and documented, and the first buildings have been successfully renovated.

In addition, the planners decided last fall that the historic buildings on the street to the north (Area Hua Shan Xi Road) should not be sacrificed to a road-widening project, and that the remaining part of the cohesive district of small-scale wooden houses east of the historic city center should not be completely and unconditionally sacrificed to a large building development and shopping mall. Kunming's Historical Building Protection Office made public its plan to extend efforts to the entire rest of the city in 2003 and 2004, where many other smaller and larger areas and building groups await discovery and rescue.

Unfortunately, the Kunming Historical Street Block and Building Protection Office is limited in its efforts to act on public interest in preservation, by lack of a preservation or protection statute in the legislative framework, or like the Canton of Zurich, a planning and building statute with articles for the protection of natural and cultural environments. The budget of the office is also very limited, as is the number of personnel, when one realizes that two architects and an archivist have to handle a large city of two million residents. Planning for the expensive, but tourism-friendly pilot project "Renovation Flower Bird-Market" for the renovation of two long rows of wooden houses and shops in the middle of the historic city center, is finished and waiting for the green light.

Moreover, private property owners – in the historic city center, around a fourth of all houses belong to private people, while the land belongs to the city – are ready to renovate their properties according to rigid preservation principles, but wish on the other hand, financial aid from the government. The city and province, however, are struggling to maintain and renovate their own old properties for financial reasons. Typically, up to six families live in cramped conditions in houses, often one family per room, and there are no toilet facilities. As a result, renovating these houses requires much more work than one would expect. In addition, each family that has to move because of a renovation has to be paid considerable compensation and be offered a comparable place to live.

How much money Kunming's Historical Street Block and Building Protection Office has at its disposal for renovations is not known. At this time, the sums needed are being discussed in city government; for example, what percentage of renovation costs or extra costs to meet state requirements for historic buildings should be paid by the state. Although laws protecting the historic city center have been passed to effectively enforce preservation aims – against the will of private property owners – there is a lack of laws and models for all of the issues.

7 Acting Sustainably

During the last four years, I have been to Kunming eleven times, often accompanied by Margrit Christensen and a representative of Zurich's Department of Historic Preservation. There have been highs and lows in our collaborative efforts. The discussions with our partners and officials in Kunming were always intensive and often led to misunderstandings due to the language barrier and cultural differences. Often we left Kunming disappointed, but were then surprised on our next visit by successful developments which arose from our efforts. Our advantage is that as a result of our intensive collaboration and professional exchanges, we have a responsible and reliable partner for preservation work in Kunming, and since the establishment of the Kunming Historical Street Block and Building Protection Office, an equivalent institution with the same powers and aims with which to work.

This collaboration in historic preservation within the framework of the city

Old Town Protection:
Manual for Inhabitants of the Wenming District

1. *Extent of the historic Wenming district of Kunming*
The Wenming district (the area bordered by Zhenyi Road in the east, Shifudong Street and Yunruixi Road in the west, the Confusius Temple and Shengli Square in the north, and Jingxing Street in the south) has been declared the "historic Wenming district of Kunming" by the municipal government.

2. *Responsible authority within the Kunming Municipal People's Government*
The responsible authority for planning administration within the municipal government – City Planning Administration (CPA) – has established a new department, the 'Kunming Historic Street Block and Building Protection Office', which is responsible for the protection of historic street blocks and buildings.

3. *The 'Kunming Historic Street Block and Building Protection Office' has set up the Inhabitants Advising System for the protection of historic buildings.*

4. *Provisional rules for living, usage and renovation within the historic Wenming district of Kunming*
These provisional rules have been devised according to the "Protection Rules for the Historic Cultural City of Kunming", "Administrative Rules for Urban Planning in Kunming", "Administrative Rules for Outdoor Advertisements in Kunming" and "Protection Plan of the Historic Wenming District" approved by the Kunming Planning and Construction Committee.
• The historic heritage, the integral appearance and the cultural landscape of the historic Wenming district shall be entirely protected.
• Inhabitants of the historic Wenming district shall follow the instructions of the urban planning administration the city appearance administration and supervision.
• Inhabitants of the historic Wenming district must observe the "Protection Plan of the Historic Wenming District". While living in the traditional houses, they are responsible for the protection and renovation of these houses.
• It is forbidden to establish buildings or constructions around traditional houses or in courtyards of traditional houses without permission. Those already built without permission shall be demolished by the inhabitants as soon as possible.
• Without permission, it is forbidden to destroy or change the original structure and space of traditional houses, to add new buildings or to demolish existing buildings.
• It is forbidden to change original colors, decorations and building materials of traditional houses without permission. All advertising installations in this district have to be approved by the Kunming City Appearance Administration Agency and the Protection Office.
• Rules concerning fire protection and fire extinguishing are to be observed.
• Any preservation and renovation measures of traditional houses must be approved by the 'Kunming Historic Street Block and Building Protection Office' of CPA and CPA's Panlong branch. Preservation and renovation plans (texts and figures) are to be submitted. Any preservation and renovation work will be accompanied by technical advice and supervision.
• The 'Kunming Historic Street Block and Building Protection Office' will send engineers to advise on and coordinate construction work in connection with historic street blocks and buildings.

5. *Legal measures resulting from infringement of the rules.*
Breaches of the provisional rules mentioned above will be dealt with by the 'Kunming Historic Street Block and Building Protection Office' and the Kunming Urban Planning Control Corps according to the "Administrations Rules for the Urban Planning of Kunming", the "Protection Rules for the historic cultural city Kunming", the "Administration Rules for Kunming City Appearance" and the "Administration Rules for Outdoor Advertisements in Kunming".

8. *Application And Approval Procedure of Preservation and Renovation of Traditional Houses:*
• Application for preservation and renovation of buildings by the owners of traditional houses;
• Advisory session (every Tuesday morning) at the 'Kunming Historic Street Block and Building Protection Office';
• Filling out of application form for preservation and renovation of traditional houses, submission of relevant documents, preservation and renovation plans and explanations, establishment of project which will be send to the City Planning Administration (CPA) Panlong Branch;
• Technical analysis on site, concept examination and approval carried out by the 'Kunming Historic Street Block and Building Protection Office';
• Receipt of licence and notification for the start of the construction work;
• Start of the construction work, accompanied by co-ordination, advice and supervision by historic building protection engineers;
• Completion and approval carried out by the Kunming Historic Street Block and Building Protection Office'.

Due to its long history of over 2000 years, rich historic heritage, charming gardens, springlike climate throughout the year, poetical landscape and variety of ethnic cultures, the city of Kunming was one of the first famous historic and cultural cities of China to be acknowledged by the Chinese State Council in 1982. Despite this, large-scale modernisation in the old town in the subsequent 10 years meant that some traditional street blocks and buildings of Kunming disappeared forever and the structure and specific atmosphere of historic street blocks was massively impaired.
While enjoying modern culture, don't we miss the old town of Kunming as our memories of it fade away? Don't we appreciate its long history like a ray of sunlight on a long and rich life?
A city needs memories. People living in the city also need to hold on to its history as a valuable heritage. On every street, every house, every door and every window, history has left its traces in various details. Like heaven and earth, sun and moon, these traces outlived their times and joined the never-ending river of life. Only cities with a history have a soul and myth. People who appreciate history can derive from it inspiration and creativity. Let's take responsibility together in protecting historic street blocks and buildings, and keeping our memory of our city under the blue sky, on the rich earth, in our eyes and our hearts.

Depth and silence harbour heartfelt thoughts.
The lens at the entrance to the alleyway discovers
long lasting colors.
The short and clear music of the stone paving
is knocking on the thick door.

Fig. 13: Manual for the inhabitants of the Wenming District.

partnership between Zurich and Kunming is planned to last two more years. By this time, Kunming should have its own well-paid employees and an experienced department functioning in this area that can perceive and act on issues of historic protection and preservation in the entire city. However, whether the buildings in the protected historic center, which are in very poor condition, can be saved is now dependent on the political willpower of Kunming officials and decision-makers.

Notes

[1] http://www.unescobkk.org/culture/heritageawards/jinlan.htm

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Sustainable Rural Development Based on Cultural Heritage

The Case of the Shaxi Valley Rehabilitation Project

In China today, 70% of the population still live in rural and mountainous areas where poverty and economic underdevelopment are widespread. Shaxi Valley, which is located at the foothills of the Himalaya in Yunnan province and remains one of the last strongholds of the Bai minority, is not only an example of an economically impoverished area in Central China but boasts the historic market square of Shaxi, which was selected on the list of the 100 most endangered World Heritage Sites by the World Monument Fonds (WMF) in 2001. The Shaxi Rehabilitation and Development Project focuses on the sustainable development of a rural commune by generating a framework for ecological, economic, and social issues which balance development and conservation in the long run. Tourism will not be the sole vehicle for the viability of the Shaxi Valley communities but only one of four tiers – alongside a well-maintained structural environment, improved infrastructure, and economic diversification. The comprehensive regional planning includes a zoning and transportation plan, a plan for sustainable basic infrastructure, a tourism development plan, a protection and development plan for historic sites, and an investment plan.

Fig. 1: Natural assets of Shaxi Valley (photo: Jacques Feiner).

1 Introduction

In contrast to the concept of the Chinese countryside, which was at the core of the Great Cultural Revolution, the Chinese authorities currently place much emphasis on the development and transition of urban areas and metropolitan regions in China. Besides the interest of post-reform China in urban areas, there exists a growing body of scholarly literature on the processes and impacts of rapid urbanization and the development of global cities in China (Chan, 1996; Wu, 2000; Yulon & Hamnett, 2002; Olds, 1997; Chang, 1998; Han & Yan, 1999; Lin, 1999). This widespread interest in urban China obscures the fact that today 70% of China's population still live in rural and mountainous areas.

Since 1978, China has been moving away from Mao's balanced regional development policies to pragmatic uneven regional development, which regards disparities as "an inevitable stage in the development process" (Long & Ng, 2001, 215). During the 1990s, China was characterized by ongoing reform and economic restructuring and strong economic growth of the main metropolitan centers, especially in the coastal regions. Simultaneously, an increased lagging behind of the interior regions, i.e. the central and western provinces, has been reported (Hare & West, 1999; Xu & Tan, 2001; Xu & Zou, 2000; see also Lee & Lee, [2002]) in this issue of DISP). The "lagging behind" of China's interior regions is even more pronounced in their rural and mountainous areas than their urban cores. When it comes to regions that are primarily populated by ethnic minorities who mostly live in badly accessible areas, the gap has grown even larger. As rising regional income inequality poses the threat of slowing economic growth, increased social conflict (Hare & West, 1999, 476), the destabilization of rural settlements, and floating urban centers with rural to urban migration, sustainable economic transformation of rural areas is a paramount task.

But although the massive transformation of the Chinese countryside and rural systems has been judged by different scholars (Hare & West, 1999; Xu & Tan, 2001; Seeborg et al., 2000) and policymakers who pay attention to the rural enterprise sector, rural China still takes a back seat.

The "Shaxi Rehabilitation Project," located in a remote valley at the foothills of the Himalaya, is situated exactly in such a rural retreat area. Due to its position in an interior region and its high altitude, the valley remained poor and did not develop much in the last 50 years. In addition, it did not prepare itself at all for second industry development. Poverty is thus widespread. On the other hand, slow or even non-existant economic growth resulted in countryside that is still very much in shape. Much of its cultural heritage survived, whereas in other locations it disappeared a long time ago (Rozelle et al., 1997). Not without reason, Sideng Market, the historic Market Place of Shaxi Valley, originally a one way station on the Tea and Horse Caravan Trail between Yunnan and Tibet, has been identified as the last surviving caravanserai-like stopover on this branch of the southern Silk Road. As such, Sideng Market was classified worthy of preservation by the World Monument Fund, which selected it for its list of the 100 most endangered World Monument Sites.

Fig. 2: Shaxi Market: A World Monuments Fund Site.

The Shaxi Rehabilitation Project is an alternative planning and development project which aims at illustrating how rural communes and their society and economy can be developed in a sustainable way by taking advantage of specific local potential and assets. The challenge of the Shaxi Rehabilitation project is thus to develop tourism and other industries in the valley, while preserving and rehabilitating its cultural heritage, its ecological qualities, and its social structure.

2 Shaxi's Great History, Present-day Problems, and Future Challenges

Shaxi Valley is located between the cities of Dali in the South and Lijang in the North, each at approximately two to

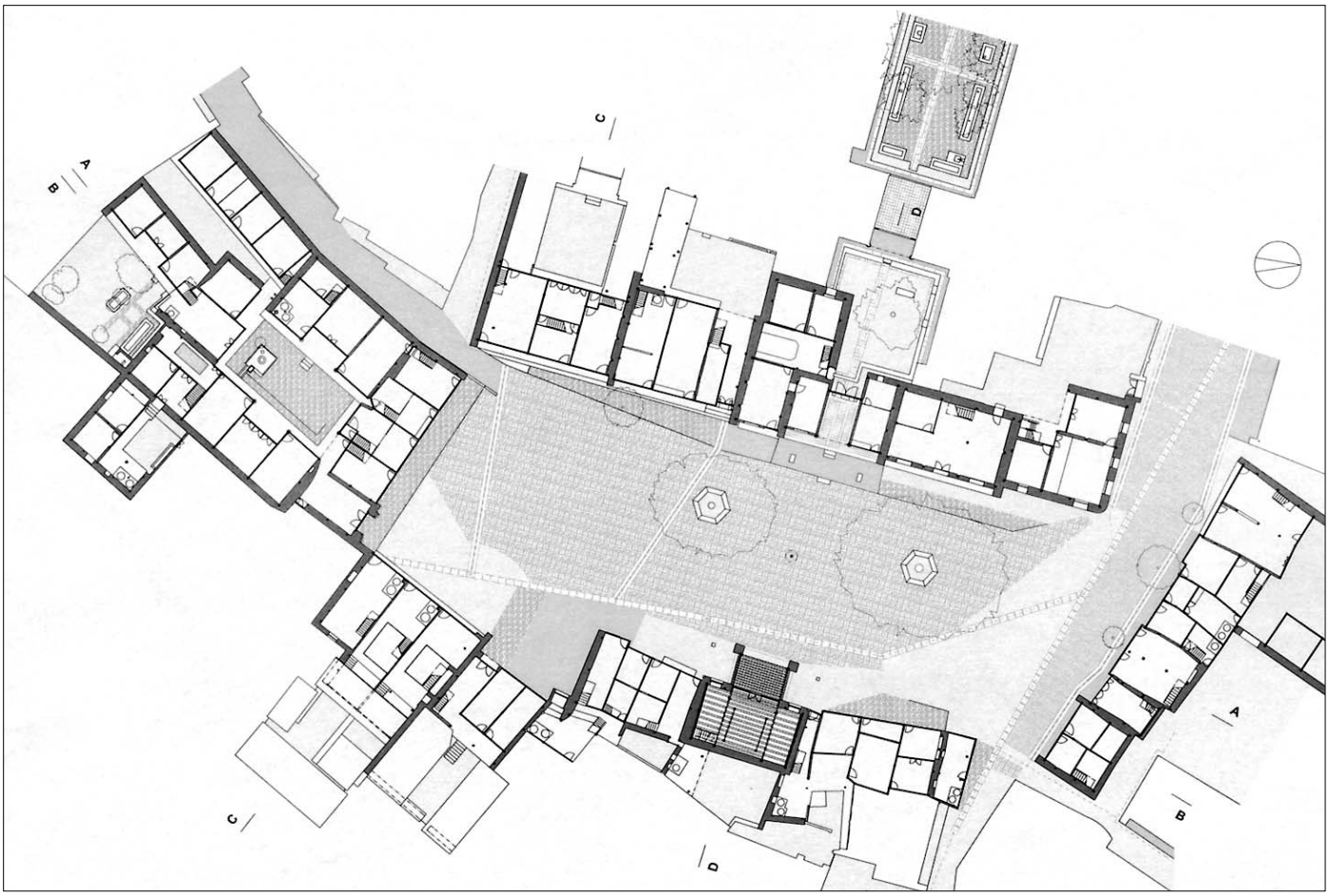


Fig. 3: Structure plan (ground floor) of the buildings on Shaxi Market (Survey: Fachhochschule beider Basel FHBB/Prof. Patrick Gmür).

three hours travel time. It is inhabited mainly by the Bai, a Sino-Tibetan ethnic group, which once dominated large parts of Yunnan Province. Jianchuan county remains the last stronghold of the Bai minority, with more than 90% of population share. Archeological findings suggest that Shaxi has been continuously inhabited since prehistoric times. Trade relations between this region around Shaxi and central China can be traced as far back as the Shang Dynasty (1600 to 1012 B.C.). Seashells found among remnants hint at an early relation with near coastal regions in southeast Asia. Researchers postulate that the South Silk Road, which crosses Yunnan in a northeast-southwestward direction and passes by Jianchuan and Dali, may have connected China and India since around 100 B.C. At that time an intensive exchange between the Chinese and Indian cultures had started to influence the regions along this trading road and thus also the region around Shaxi.

With the passing of time, the traditional trade routes along the north-south flowing Mekong River and Red River changed functions. Beginning around the sixth century, trade in tea and horses started between Yunnan and Tibet. This trade route extended about 3,500 km, from the tropical south of Yunnan, Xishuangbanna, where tea was cultivated, to Lhasa in Tibet, where horses were bred. Horse caravans were the typical means of transportation. Shaxi was one of the important stopovers on this trade route, the second before the ascent to the Tibetan High Plateau. The Tea and Horse Caravan Trail between Yunnan and Tibet led essentially to a kind of civilian exchange between all ethnic groups involved, including Bais, Chinese, Tibetans, Indians, Yis, Thais and Burmese, among others. This diversity of exchange stands in contrast to the Silk Road, which came under the strict military control of the dominating powers. The apogee of cultural exchange on this route occurred during the Nanzhao (8th to 10th century A.D.) and Dali (10th to 13th century A.D.) periods. The impressive reliefs in portraying the two royal courts in the Shizhong Temple Grottoes in Shibao Mountain in the northwestern part of the Shaxi commune testify to the importance of Shaxi in these extended empires; in the background architectural elements which are still common in the Bai traditional building style can be seen. Stone statues of buddhas, kings, monks, and other dignitaries, as well as animistic symbols, show traces of merging religious and cultural elements (850 to 1179 A.D.), from Buddhist, Chinese, South Asian, and Tibetan to Persian origins. The importance of the trade route may also explain the comparatively high standing of the local vernacular architecture and the high quality of the decoration and construction of many houses in the Shaxi Valley.

With the change of political systems and the introduction of modern transportation in the 1950s, trade on the Tea and Horse Caravan Trail came to a definite end. Shaxi, completely dependant on this trade route, stagnated, and only limited development has taken place in the valley since then. Centered in an isolated valley and surrounded by fierce mountains, Shaxi Valley has preserved the once typical combination of cultural, religious, commercial and architectural components of the region to this day. What remains is the structural heritage in the valley and the local indigenous culture. There are about 50 temples in the valley dedicated to a series of different gods. The most important is the above mentioned Shizhong Grotto Temple on Shibaoshan Mountain. The market area of Sideng Village, probably the last existing stopover on the historic Tea and Horse Trade Route, serves as a rare example of historical commercial architecture. It is confined by defensive gates and furnished with a theater stage and many wooden shops. A temple district and a host of sanctuaries are located in the immediate proximity of the historic market. A series of impressive traditional residential houses are also found in the proximity of this market place. Today, the Shaxi commune covers an area of 288 km, has eight villages and approximately 20,000 inhabitants. But due to natural population growth and current restrictive migration policies (which prevent people from moving away from the valley), the population of Shaxi Valley is forecast to increase greatly: at the end of 2020 around 34,000 inhabitants are expected. This anticipated 70% increase in population will strongly increase the land-use for settlements; this development threatens prime quality arable land in the valley plain. The average yearly income lies at approximately US$120.

This is very low, even when compared with Chinese conditions. One of the main economic constraints to the valley has been its location as a dead-end and the lack of mining resources. Agriculture is the primary source of income for 70% of the economically active residents. But as Shaxi is located at about 2,300 meters above sea level – the highest altitude where wet rice can still be cultivated – only one harvest is possible. It is estimated that an additional 15% of the economically active population work in the secondary industries. Construction work accounts for two-thirds of the secondary industrial sector. Stone and wood carving and architectural building craftsmanship in the commune are strong traditional businesses, as they are in other parts of Jianchuan county. Skilled carpenters and wood and stone carvers are contracted for construction and renovation projects throughout the province, including Kunming, the capital of Yunnan, as well as in other parts of the country. The third sector, which includes services and public administration, accounts for about another 15% of the total economically active population. Secondary and tertiary industries currently satisfy only the needs of the resident agricultural population. Despite the natural beauty and the impressive structural heritage, tourism remains only marginally developed and is limited to visits to Shibaoshan Mountain.

Population growth and lack income drives residents more and more to overuse the natural environment. The risk of further destruction of natural potential is increasing (i.e. deforestation, despite legal measures), and with it the risk of natural disasters such as landslides, floods and droughts. Thus, the question at hand is how long the current natural

beauty of the valley, the preservation state of its settlements and the unique cultural identity of its inhabitants can prevail under present conditions. In addition, the Bai culture, with its own language, its distinct festivals, dances and traditions, is nowadays in danger of fading out in favor of the mainstream Han-Chinese culture. The same applies to the Bai building heritage, which is often in desperate shape. However, the provincial Ministry of Culture has recognized the surrounding cultural landscape as deeply influenced by the Bai ethnic minority and intends to suggest it to the UNESCO World Heritage List as a landscape especially in need of protection.

3 Cultural Heritage Preservation and Rural Tourism as a Means of Sustainable Development?

Currently, 730 properties (563 cultural, 144 natural and 23 mixed properties in 125 states) are included on the World Heritage List, which was established under the terms of The Convention Concerning the Protection of the World Cultural and Natural Heritage adopted in November 1972 at the 17th General Conference of UNESCO. As these sites have global value due to their specific historical, scientific, or aesthetic qualities, many of them attract tourists from all over the world. This is in line with the philosophy underlying the convention that designated sites are to be open to visitors. However, tourism initiated by World Heritage Sites generates revenues and draws global attention to these sites and their cultural assets, but at the same time it can pose a severe threat to the environment and to culture, thus conflicting with the goal of protection and conservation of cultural heritage (Drost, 1996). The close links between cultural heritage and tourism inevitably lead to a discussion of sustainable development, which means "development that meets the needs" of the present without compromising the ability of future generations to meet their own needs (WCED, 1987), while taking into consideration ecological, economic as well as social issues. Based on the concept of sustainable development, the World Tourism Organization (WTO) defined the main elements of "sustainable tourism" in 1995 as follows:

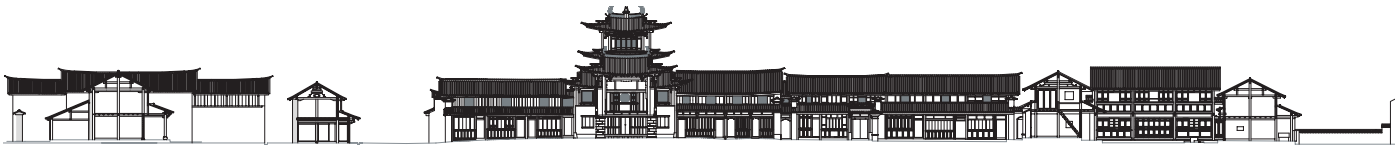
- Improvement of the quality of life of the host community.
- Maintenance of the quality of the environment.
- High quality of experience for the visitor (WTO, 1995).

Though Miller (2001) emphasizes that the definition of sustainable tourism is still not satisfying in many areas, it is commonly agreed that the focus of sustainable (tourism) development has to be on long term viability as well as the issues of equity, justice, empowerment and participation (Hall, 1998; Ahn et al., 2002; Miller, 2001). A review of definitions of sustainable tourism is given in Garrod & Fyall (1998, 201).

A sub-category of sustainable tourism is ecotourism, which is currently growing in popularity and is believed to be the fastest growing tourism segment (Campbell, 1999). Ecotourism includes issues of ecotourist responsibility, environmentally friendly destination management, profit linkage to conservation efforts, and the sustainable development of local human populations (Campbell, 1999). A review of ecotourism definitions is given in Blamey (2001). A very strict view of ecotourism is defined by Ziffer (cit. in Hjalager, 1997, 39): "The eco-tourist practices a non-consumptive use of wild-life and natural resources and contributes to the visited area through labour and financial means aimed at directly benefiting the conservation of the site and the economic well-being of the residents. The visit should strengthen the ecotourist's appreciation of conservation issues in general, and also the specific needs of the locals. Ecotourism also implies a managed approach by the host country or region, which commits itself to establishing and maintaining the sites with the participation of local residents." According to the literature review by Campbell (1999), community development, community participation, a community approach to decision-making, and small business development are central principles of the ecotourism concept. Concerning economic impacts of ecotourism, Lindberg (2001, 363) summarizes that "several studies have assessed the local employment benefits of ecotourism; not surprisingly, the level of benefits varies widely as a result of differences in the quality of attraction, access, and other factors. In some cases, the number of jobs created will be low, but [especially] in rural economies even a few jobs can make a big difference."

Despite widespread efforts towards more sustainability of tourism, the impact of tourism on a region's environmental diversity and fragility is still very far-reaching, and as Ahn et al. (2002, 2) point out, "the enthusiasm for linking sustainable development with tourism may often be tempered by reality." In scholarly literature, a wide range of potential land-use, conservation, social, and economic priority conflicts are reported, in addition to environmental degradation (Hall, 1998; Ryan, 2002; Russo, 2002). Buckley (2001) points out that even though ecotourism has lower per capita impacts on the environment than traditional forms of tourism, these impacts tend to be concentrated in areas of highest conservation and protection value. According to Buckley (2001), environmental impacts of ecotourism can be reduced by management practices of ecotour operators and landholders/land management agencies, and the environmental education of ecotour clients.

Considering the more general topic of sustainable tourism, Collins (1999) argues that market instruments may not help correct spillover effects caused by the abuse of tourist-carrying capacities before significant environmental degradation occurs. Visitation fees, route guidance and the designation of tourist zones are widely used but have proven ineffective (Collins, 1999). Campbell (1999) even suggests that sustainable tourism development cannot be achieved in the absence of formalized planning or intervention. Ahn et al. (2002) point out that sustainability is an attractive but problematic concept contradicted by the absence of a mandate for the sustainability of some quality of life among regional communities. In



their study on Calhoun County, Texas/USA, Ahn et al. (2002) identified the Limits of the Acceptable Chance (LAC) planning framework suggested by McCool (1994, 1995) as a potential technical planning process tool to help define operational guidelines for sustainable tourism development. According to Collins (1999), the goal of achieving more sustainable tourism development has to be met by strategic coordination, planning, and enforcement on a spatially extensive basis, whether community or government led.

Special interest in tourism development has been paid to rural tourism. Rural tourism is seen as a significant source of income for peripheral areas (Hummelbrunner & Miglbauer, 1994), as a means of re-populating rural areas, maintaining and improving public services, and as a solution for the protection of both the natural and structural environment (Sharpley, 2002, 234f.). Therefore, it is "considered an effective catalyst of rural socio-economic development and regeneration." (Sharpley, 2002, 233). Hall (1998) suggests that in China, well integrated high quality rural tourism is able to provide a substantial complement and counterbalance to coastal mass tourism and can generate considerable employment in sectors such as accommodation, food, local crafts, manufacturing, construction, as well as improve the quality of local housing. Besides bolstering the local economy, rural tourism is regarded as a more sustainable tourism approach than conventional tourism (Sharpley, 2002) and a vehicle for sustainable development (Hall, 1998). Therefore, in many countries, economic challenges and social destabilization caused by the decline of traditional agrarian industries and falling employment and income levels in rural and mountainous areas are addressed by rural tourism development programs. As Hall (1998, 428) notes concerning rural tourism, "attractive landscapes or particular elements of the natural environment can complement and provide the context for cultural attractions." Prospects for regional development in peripheral areas through exploitation of the assets offered by cultural heritage and an untouched natural environment are demonstrated by examples from Europe, the Americas, and Asia (Hall, 1998; Sharpley, 2002; Campbell, 1999; Tosun, 2001).

4 The Shaxi Rehabilitation Project

4.1 Shaxi's Main Assets for Future Development

Besides the already frequented Shibaoshan Mountain, there are many other historical sites and natural spots, which indeed would be worth visiting. However, most of them are still unknown to the public and would need, due to their desperate state of conservation, urgent care and restoration.

The natural landscape of Shaxi Valley is well-preserved up to now. The landscape is idyllic, the villages' structures are still completely built in the distinctive Bai style. The rice terraces and the man-made natural environment are also fully intact, and forest grow on the mountain slopes. The remote location surrounded by mountainous forests at high altitude is an ideal location for the production of organic agricultural products. Rare cash crops (mushrooms and ginseng, among others) also grow in abundance, but are exported as raw materials and do not generate additional income. Cash crops and organic food production already have the potential to improve the local economic environment. Furthermore, the development and export of existing second industry skills, e.g., wood and building craftsmanship, and building conservation, presents a further prospect for development. In general, the landscape, nature and man-made environment is enticing for visitors, but so far little or no tourism infrastructure exists.

The Bai culture is still alive – more than 90% of the population speak the local Bai language – and can be experienced by visitors as can the culture and traditions of the other minorities such as the Yi. Festivals, music and dance events are frequent and usually colorful. Besides this, the local population is very adaptable and has many skills, and they just lack respective markets to flourish in. Thus, if circumstances change, the expected population growth could also represent local potential. In this sense, carefully guided settlement growth and conscious preservation and development of historic sites and settlement cores could only add to the valley's attractiveness.

There are obvious potential synergies between population, tourism, and primary and secondary industry development, which need to be carefully tapped:

- The population increase may be converted into an opportunity.
- The high altitude location, which is unfavorable for agrarian production, may change into an asset for tourism development.
- The protection of cultural and natural heritage may become a development prospect.
- Tourism may become the main motor of social and economic development.
- Other social and economic opportunities may add to this.

One more main development asset is the strong commitment from the local side and the strong desire to develop the valley in a positive way. When the historic market square of Shaxi was selected for the list of the 100 most endangered World Heritage Sites by the World Monument Fonds (WMF), the local government mobilized around 200 journalists and 11 TV stations to attend the press conference. It has also already issued construction regulations to protect the valley.

By far the main economic potential for the future lies in tourism. While Sideng Village did not have any tourists before the listing of Shaxi Market Square by WMF in November 2001, this has already changed. Around 10,000 tourists visited it so far during 2001. In the last decade, two main tourism hubs have developed with about three hours reach from Shaxi: the cities of Dali and Lijang. Dali generates about 5.5 million tourists each year, and Lijang around 3.5 million (2001). These hubs are increasingly overcrowded and tourism experts are seeking alternative locations. On the other hand, if only 1 to 5% of these tourists could be convinced to visit Shaxi, this would have a considerable

impact on the local economy. For this, however, the infrastructure, which is currently lacking, needs to be prepared.

The main challenges and potentials enumerated show clearly that in the current situation much can be lost or won in Shaxi Valley. In the medium term, if not carefully planned and guided, the nearby exponentially increasing tourism in the region could even become a threat to the natural and architectural heritage of the valley, especially if Shaxi were to deal with its dead-end geographic location by constructing a bypass road. Therefore, effective protection measures should be put in place, and future settlement growth needs to be guided by comprehensive regional planning. Otherwise, Shaxi risks loosing its precious natural and cultural assets in the medium term.

4.2 Planning Objectives of the Shaxi Rehabilitation Project

As indicated by academic literature as well as preceding surveys by the authors in Shaxi, an isolated restoration and tourism project for the Sideng Market in the Shaxi Valley will not be sufficient to preserve the heritage site. Moreover, an integrated and comprehensive planning project, focused on the preservation of the site and the improvement of the economic and ecological situation in the valley appear to be necessary if the goal is to reach a sustainable and enduring preservation and development in Shaxi Valley. Otherwise, the restored buildings would fall into decay again some years after the end of the program and severe degradation of the natural assets would occur. Therefore, the four main objectives of the Shaxi Rehabilitation and Development Project are as follows:

- Enable a sustainable rehabilitation and development of the Shaxi Valley. This shall be done by tapping the potentials of the valley (environmental and cultural preservation, and the development of tourism and other economic growth prospects.)
- Enable the development of Sideng Village as the central location of the Shaxi commune (it being the core part of future settlement of the valley), and the preservation of the historic part of Sideng, in addition to the other historical assets of Shaxi Valley.
- Ensure the restoration and re-integration of the historic marketplace of Sideng Village.
- Set a model for sustainable rural development in the culturally rich area of the Himalayan foothills. This model is urgently needed, as many other similar areas are on the verge of being destroyed. Setting an example of how rural sustainable development can take place in such a mountainous region is therefore one of the main objectives.

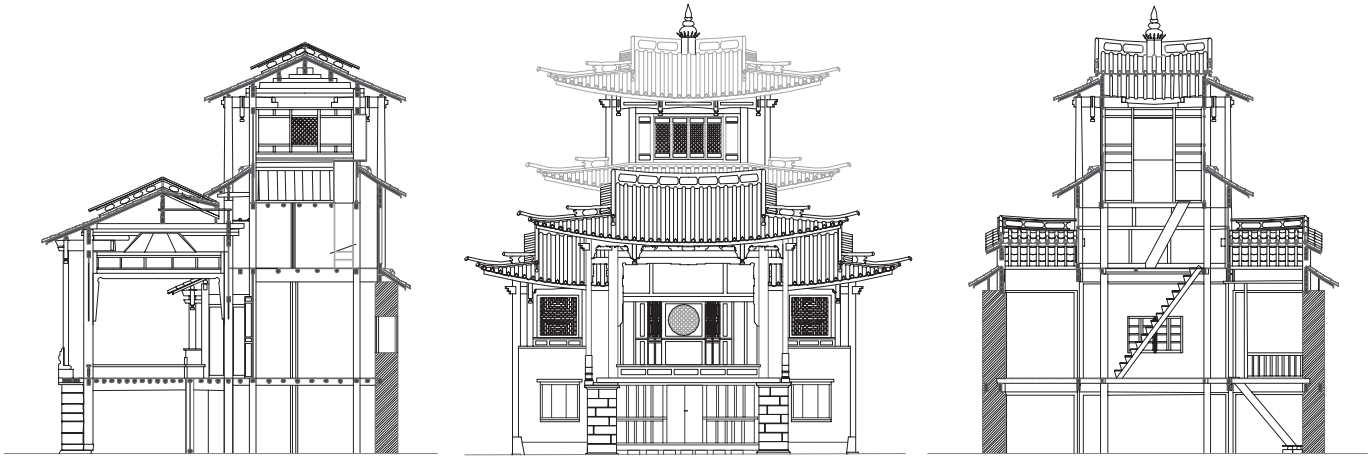
Fig. 4: Traditional Bai Theater Stage at Sideng Market (photo: Jacques Feiner).

4.3 A Sustainable Vision for Shaxi Valley

How the future of Shaxi Valley could look is described in the following development vision.

On entering and looking over Shaxi Valley, the visitor is stunned by the visual appearance of the valley as a whole. It appears as an idyllic island in a sea of dark-green, forest-covered mountains. The rice-field terraces of the valley-plains stand out, shiny-green and organically cultivated, while compactly built villages are regularly distributed over the whole plain. The tile-covered roofs of the traditional courtyard houses glitter in the morning sun. On arrival in central Sideng Village, we see a market place for weekly markets which lies between the well-organized village center and the well-preserved historic village. People dressed in styles according to their ethnic group stand around, talk and exchange goods. This traditional image, however, hides modern aspects. The historic village, the old market square, and temple district are well restored, but adapted in function to contemporary needs. They add to the local identity, of which the residents are proud. Sideng Village has become the focal point of the valley. Here, the non-agricultural population, the services and secondary industries are concentrated

Fig. 5: Restoration proposal of market facades.
FHBB (Fachhochschule beider Basel) collaboreted on the architectural survey.



on the natural hill of Sideng, where the agricultural land is only of secondary quality. The sanitation system is built so as to protect bodies of water, and its output can be used as fertilizer for local organic food production. Riverside areas and biotopes close to the town are protected and made accessible, enticing visitors to undertake short and romantic evening trips. A network of walkways covers the valley and mountains and is used by both inhabitants and tourists. They can travel safely by bike, by horse, or on foot by separate pathways. The original tea and horse caravan trails are restored and can be experienced again in their original character. Several hotels are located around historical Sideng Village and at distinct locations in the Shaxi Valley. They incorporate and reinterpret the distinct Bai building style and offer overnight stays with a distinctive note to the visitors. A series of restaurants offer the visitor a taste of local food. The number of visitors is in balance with the local population and local incomes are improved leading to a decent lifestyle. In addition, nature is in balance with the economic development, and natural potentials are used and safeguarded simultaneously. Briefly stated, the village is both attractive to visit and to dwell in.

4.4 Comprehensive Planning as a Means for Sustainable (Tourism) Development

To ensure a healthy environment and a sound economic base, a sustainability-oriented comprehensive development plan for Shaxi Commune will be established. It includes:

- A comprehensive zoning and transportation plan. A novelty for China, this plan addresses the whole area of the commune and outlines settlement core and development zones, nature priority and protection zones, and other areas of common interest.
- A plan for the implementation of sustainable basic infrastructure. Currently, specialists from the Swiss Federal Institute for Environmental Science and Technology (EAWAG), a Swiss Federal Research Institute, are at work to establish a sustainable sanitation system for historic Sideng Village. It includes both liquid and solid waste. Its main advantages are that a (very expensive) sewerage system will not be required and that human and animal waste will be used for soil fertilization, increasing at the same time the capacities of organic food production. Sideng Village will be the pilot project for other villages in the Shaxi Valley. In addition solid waste, water supply, drainage and grey water are addressed.
- A tourism development plan. Tourist itineraries, sites of interest to tourists and potential locations for hotels and other related infrastructure are outlined.
- A protection and development plan for Shaxi's historic sites. This plan caters for preservation, adequate restoration and re-linking of the historical sites in the valley.
- Creating sustainable investment opportunities. In line with the development of the comprehensive development plan, a phased and adapted investment plan for the commune will be worked out. Its goal is to allow the community to apply for infrastructure funding to the provincial and national authorities and to offer a base for private investments. With this funding and other investments, which are already partially promised, the development vision for Shaxi Valley will be realized.

4.5 Rehabilitation and Development of Historic Sideng Village as the Core Part of Sustainable Tourist Development in Shaxi Valley

The core of the future population and economic development of Shaxi Valley is Sideng. Meanwhile, the historic part of Sideng Village and its immediate surroundings are clearly the core areas for future tourism development. To assure that this development will be sustainable and not threaten the historic fabric and sensitive wetland along the river in front of the village, detailed preservation plans and regulations, as well as urban and landscape design plans have been worked out. These provide for protection and development areas and a framework for development of new tourism-related structures close to the historic village as well as a scheme for replacement of collapsed buildings inside their old fabric.

Meanwhile, the historic market place, with its theater stage, the Sideng Temple District, which dates back to the Ming Dynasty (1415 AD), and the other historically most important houses in the village have been carefully surveyed. Future functions for reuse of the partially abandoned buildings around the market square have been defined. Detailed restoration and rehabilitation plans are being drawn up. Adaptations outside the historic village have been carried out in a manner that makes the historic market square once again an attractive place to host a part of the local weekly market and cultural or tourism-related functions have been assigned to some of the abandoned buildings.

Every effort is being made to ensure that the historic Shaxi Market Square again becomes an attractive meeting place for local residents as well as for visitors from abroad.

5 Conclusion

Although the Shaxi Rehabilitation Project adapts the principle ideas of sustainable tourism development, rural tourism, and ecotourism, its overall philosophy reaches far beyond the limits of tourism development. The comprehensive planning and development approach used in the Shaxi Rehabilitation Project focuses on the sustainable development of a rural community by generating a framework for ecological, economic, and social issues which balance development and conservation in the long run. Tourism will not be the sole vehicle for the viability of the Shaxi Valley communities but only one of four tiers alongside "a well-maintained structural environment, improved infrastructure, and a diversified economy." The overall findings of the Shaxi Rehabilitation Project with regard to the principle of sustainable development are that sustainable tourism development in remote rural areas cannot be achieved without focusing on sustainable community development and establishing comprehensive planning frameworks and guidelines.

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