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Urbanization in the Pearl River Delta Economic Zone, China

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SUMMARY

The Pearl River Delta Economic Zone (PRDEZ) is one of the most vigorous economic regions in China, and even in the world. Since the economic reform and opening up to the outside world, PRDEZ has been undergoing rapid urban expansion. based on a large number of investigative data, three indices (expansion coefficient of urban land, harmonious coefficient between population and cropland, and benefit coefficient of urban land) were designed and used to discuss the interrelationships between urbanization, economy and land use. The results suggest that urbanization is not the main reason for a reduction in cropland in the study area. In contrast, urbanization has the following advantages: 1) Urbanization of the rural population favours the release of land from rural residential area; 2) Urbanization can help to improve the city's agglomeration effect in terms of both population and economy; 3) Urbanization can contribute to improving the degree of intensification of land use; and 4) Urbanization can help to improve land-use efficiency. Therefore, urbanization may be an effective way to solve the contradiction between 'more population and much less land' in the study area.

INTRODUCTION

It is well known that urbanization is inevitable in the development of human civilization. It is also a representation of the degree of development of both the economy and society. The promotion of industrialization in developed countries entered an advanced stage of urbanization as early as the 1950s (Chen and Chen 2002). In order to explore urbanization and its consequences for society, many researchers are now focusing on the relationship between urbanization and cropland (Pugh 1995; Simon 1995; Chen 2002; Gupta 2002; Ramankutty *et al.* 2002). As a developing country, the urbanization process in China has been relatively slow but

has gained momentum in the past 20 years. However, the urbanization level in China is still relatively low. Numerous researches have investigated both theory and application of urbanization in China (Chen 2000; Zhang 2001; Xue 2002; Chen and Chen 2002). As to research on the relationship between urbanization and land resources, especially cropland, two different viewpoints currently prevail in China. One suggests that urbanization occupies much cropland (Wang and Yang 1997; Chen *et al.*, 1999), and the cropland area has thus been reduced continuously because of urban expansion. Consequently, it was suggested that the

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speed of urbanization in China must be slowed. The other viewpoint suggests that urbanization can help to promote the intensification of land use (Shi 2000; Luan and Wang 2002; Ouyang *et al.* 2002), and advancing urbanization may be one of the most effective ways to resolve the contradiction between 'more population and much less land' in China.

The Pearl River Delta Economic Zone (PRDEZ) is one of the most vigorous economic regions in China, and even in the world. Since economic reform and the opening up policy were instigated, the PRDEZ has undergone a process of rapid urban expansion. Now, its urbanization level is ranked first in China. Consequently, a way to settle the conflict that exists between the increase of urban land area and the decrease of cropland area is urgently required. This will make a significant contribution to realizing sustainable development of urban areas and sustainable utilization of land resources. The rational settlement of the contradiction between urban land and cropland in the PRDEZ could provide a good example for sustainable development of other areas of China.

RESEARCH DATA AND METHODS

The authors carried out a thorough investigation of most of the areas in the PRDEZ. A large amount of original data was collected through visits and consultations with many concerned government departments. The main data sources are drawn from the *Tabulation on population censuses of Guangdong Province* (Population Census Office of Guangdong Province 1984, 1992, 2002), *Guangdong Statistical Yearbooks* (Bureau of Statistics, Guangdong Province 1988–2001), *1980–1990 National Economic Statistical Data at County (District) Level in Guangdong Province* (Bureau of Statistics of Guangdong Province 1991) and *Land Resources in Guangdong Province* (The Land Resources Bureau of Guangdong Province 1999). The selected indices include population, gross domestic production (GDP), cropland area and urban land area. Through mapping of synthetic images for wave sections 4, 7 and 1 from Landsat, data regarding urban land area were acquired. Statistical population was calculated on the basis of government household registration, which includes both agricultural and non-agricultural populations, while the population census mainly targets population

residing in the PRDEZ area, including urban and rural populations.

The actual values of cropland area, urban land area, urban population, total population and GDP will be used in the paper. In order to illustrate the relationship between increase in urbanization (ratio of urban population to total population) and land use in a clearer manner, three indices were designed and used. The variation rates during the periods from 1982 to 1990 and from 1990 to 2000 were calculated. A description of the three indices and the variation rates follows.

1. Harmonious coefficient between population and cropland (HCPC)

$$HCPC = \frac{V_{dc}}{V_{iu1}} \quad (1)$$

Here, V_{dc} is the decreasing rate of per capita cropland area for rural population; V_{iu1} is the increasing rate of urbanization. A lower value of HCPC suggests that a higher degree of harmony has been achieved between population and cropland, while a negative value implies that urbanization can help, to a certain extent, to relax the pressure that rural population exerts on the requirement for cropland area.

2. Expansion coefficient of urban land area (ECUL)

$$ECUL = \frac{V_{iu2}}{V_{ip}} \quad (2)$$

Here, V_{iu2} is the increasing rate of urban land area; V_{ip} is the increasing rate of urban population. $ECUL = 1.0$ is the value for a balance between these two, while $ECUL > 1.0$ usually implies that expansion of urban land is faster than the agglomeration of urban population. $ECUL < 1.0$ indicates that rate of increase of urban land is slower than that of urban population. Based on the urbanization situation in China, the authors consider that a value of ECUL slightly higher than 1.0 is rational for healthy economic development in China.

3. Benefit coefficient of urban land area (BCUL)

$$BCUL = \frac{V_{ig}}{V_{iu2}} \quad (3)$$

Here, V_{ig} is the increasing rate of GDP; V_{iu2} is the increasing rate of urban land area. A higher value

of BCUL usually suggests that intensification land use is higher.

RESULTS

The actual values of key economic indices, including cropland area, urban land area, GDP, urban population, total population and urbanization level for the whole PRDEZ area are listed in Table 1 for the years 1982, 1990 and 2000. This table shows that the urbanization process develops quickly in aspects such as population, land and economy in the study area since economic reforms and the opening up policy were started in China, particularly from 1990 to 2000. Urbanization of the PRDEZ had already advanced by 2000. The GDP and urban population both increased faster from 1990 to 2000, since GDP in 2000 was 8.6 times more than in 1990, and the urban population in 2000 was 3.3 times that in 1990. As to the variation trends of cropland area and urban land area, the increase in urban land area was no more than half of the reduction in cropland area from 1982 to 1990. From 1990 to 2000, the increasing urban land area was more than that of the decreasing cropland area. As indicated by results from the detailed survey of land resources by the Land Resources Bureau of Guangdong Province (1999), from 1994 to 1996 the cropland area decreased by 2153.37 km², while other types of agricultural land, garden plots and woodland, increased by 231.24 km², which is more than 10% of the total decrease in cropland area in the PRDEZ. Therefore, structural adjustment of agriculture is one of the main factors that lead to the decrease in cropland area by a large margin, while urban development took up only a very small part of the decrease in cropland area. This may help to explain why cropland reduction cannot be ascribed mainly to urban development, but attention must be focussed on the unused land in urban

areas during urban construction. This is simply because unused land can no longer be left unused and the potential of land use should be fully explored. This is the essence of so-called urbanization development. Therefore, it is concluded that promotion of the urbanization process of the PRDEZ at this time will not only be beneficial to the continuing increase of the local economy but will also push forward the effective utilization of the land in urban area.

Figure 1 gives the percentage yearly variation trends of cropland area and non-agricultural population, i.e. the ratio of non-agricultural population to total permanent resident population from 1980 to 1999, based on the household registration population statistics. The non-agricultural population percentage increased gradually while cropland area was reduced. Two rapidly changing periods can be identified from the variation trend of the non-agricultural population, one period is from 1983 to 1985, while the other is from 1992 to 1994. Correspondingly, the cropland area shows two unusually fast reduction trends from 1983 to 1986 and from 1991 to 1994. In the former period, the reduction in cropland area is delayed by one year as compared to the increase in non-agricultural population. It can be postulated that the cropland reduction resulted from urbanization of the agricultural population during the process of urbanization. In the latter period, the increase in non-agricultural population is delayed by one year as compared to the reduction in cropland area. The urbanization of the agricultural population is obviously driven by the occupation of cropland during the urban expansion process. It can also be seen from Figure 1 that the non-agricultural population increased quickly and continuously in the PRDEZ, while cropland decreased slowly. Starting from 1994, the reduction in cropland area becomes slower and slower. As a result, it can be concluded

Table 1 Actual values of some indices for the PRDEZ

Indices	1982	1990	2000
Cropland area (km ²)	9509.66	8415.51	6351.85
Urban land area (km ²)	234.81	677.85	3374.09
GDP (10000 Yuan)		9 010 053	77 118 031
Urban population (persons)	4 828 860	8 476 261	28 189 221
Total population (persons)	16 338 554	20 757 514	39 681 294
Urban percentage (%)	29.56	40.83	71.04

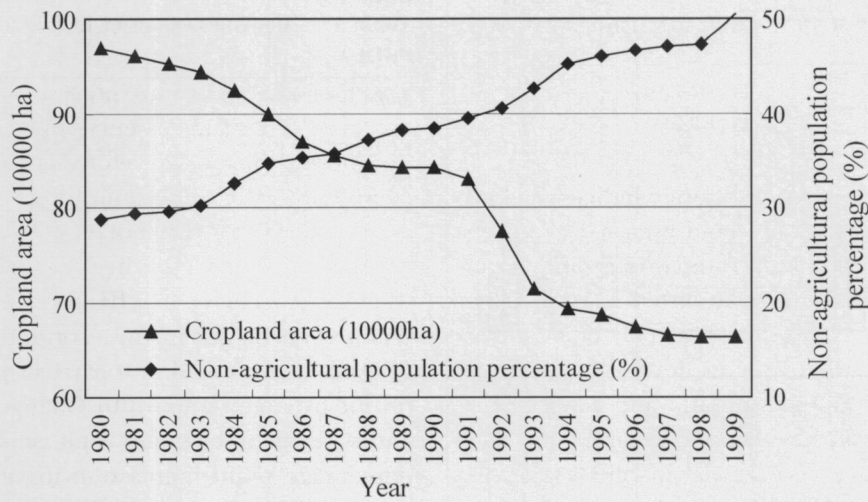


Figure 1 Yearly variations in cropland area and non-agricultural population

Table 2 Ratios of reduction in cropland area vs. increase in urban land area from 1994 to 1996

City	Guangzhou	Shenzhen	Zhuhai	Huizhou	Dongguan	Zhongshan	Jiangmen	Foshan	Zhaoqing	PRDEZ
Ratio	2.00	0.39	0.28	3.43	9.49	3.48	9.74	3.72	2.28	3.44

that urbanization will not lead to cropland reduction when urbanization reaches a certain level. The authors therefore propose that it is necessary to push forward the urbanization process of the PRDEZ area more actively, at least at present.

Based on the amount of cropland area reduction and urban land area increase from 1994 to 1996 listed in the detailed survey of land resources in Guangdong Province (The Land Resources Bureau of Guangdong Province 1999), the ratios of cropland area reduction to urban land area increase were calculated and are given in Table 2. This shows that the ratios are more than 2.0 in most areas in the PRDEZ, except in Shenzhen and Zhuhai. Shenzhen and Zhuhai were among the first batch of special economic zones established by the Chinese government in the 1970s. The cropland reduction in these two cities mainly occurred in the 1980s. From 1994 to 1996, the decrease in cropland area in these two cities was very small, but the increase in land area for city construction was very large. However, it should be pointed out that the increased land area for city construction is not based on the decreased cropland area, rather, urbanization was pushed forward through exploration of the internal potential for land utilization in these cities. In regard to other cities and districts in the PRDEZ area, the ratio is more than 2.0, which demonstrates

that the amount of the decrease in cropland area is far greater than that of the increase in the urban area. As a result, the reduction in cropland area was not fully occupied by the expansion in urban area. For the whole of the PRDEZ area, urbanization is definitely not the main cause that can account for the reduction in cropland area. Rather, urbanization can help to improve the degree of intensification for land use in this area. Therefore, the authors conclude that the urbanization process should be pushed forward in a more active way in the PRDEZ area, even in terms of efficient land use.

The HCPC values for the whole PRDEZ and for each city from 1982–1990 and from 1990–2000 are illustrated in Figure 2. The results demonstrate that the development of urbanization of the PRDEZ area has not constituted a serious negative effect on the cropland area. Nevertheless, it has pushed forward improvement in cropland use efficiency in some of the cities and districts in the PRDEZ area that are at different stages of urbanization. With regard to the entire PRDEZ area, the coordination coefficients between population and cropland in the two periods are very small, and the coefficient for the later stage is even smaller than that for the earlier stage, which suggests that, during urbanization, the decreased rate of per capita cropland area for the agricultural population is far slower than the

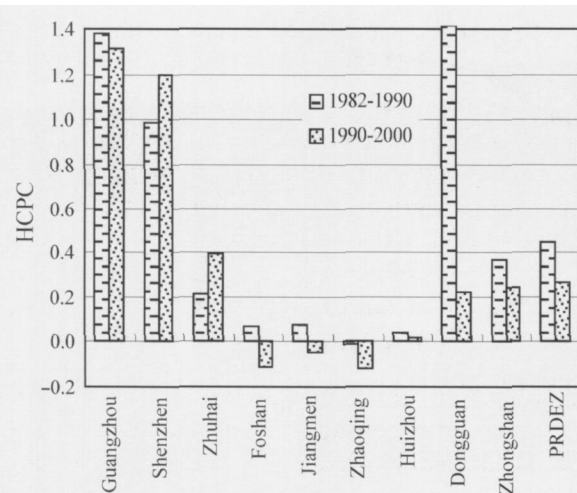


Figure 2 Variations in HCPC from 1982–1990 and from 1990–2000

urbanization rate of the agricultural population. Except for Shenzhen and Zhuhai, the coordination coefficients between population and cropland for other cities and districts all show decreasing trends. In Zhaoqing, the coordination coefficients between population and cropland in the two periods are both negative, and the coefficient for the later period is far smaller than that for the earlier period, demonstrating that, with the development of the urbanization of the agricultural population, the per capita cropland area for the agricultural population is increased, and increased to a larger extent and at a faster pace. In Foshan and Jiangmen, the coordination coefficients between population and cropland change from positive in the earlier period to negative in the later period, suggesting that urbanization has, to some degree, helped to alleviate the pressure for more agricultural cropland by agricultural population. Consequently, the agricultural population migrates into urban areas, i.e. urbanization of the agricultural population could possibly be an effective and necessary way to solve the contradiction between population and land in rural areas, not only for the PRDEZ, which faces the problem of a large agricultural population but less agricultural cropland area, but also for the entire country.

As shown in the detailed survey on land resources in Guangdong Province (The Land Resources Bureau of Guangdong Province 1999), the per capita residential land use in urban areas is 17.47 m², while that in rural areas is 99.82 m². However, the difference between these two data

Table 3 Calculated values of ECUL and BCUL for the PRDEZ

Index	1982–1990	1990–2000
ECUL	2.498	1.710
BCUL	–	1.900

sets is even bigger in the economic zones in the PRDEZ. If a calculation is carried out based solely on the average standard in Guangdong Province, and with an unchanged total population, a one percentage point increase in urbanization of the economic zones in the PRDEZ virtually means the release of 32 677 546 m² of residential land area from the rural population, which can be used for agricultural purposes. As a result, under the current situation, urbanization of the rural population in the economic zones in the PRDEZ will not lead to occupation of more cropland areas, but will probably result in an increase in land areas for agricultural purposes. Moreover, congregation of the rural population in urban areas will boost economic efficiency of urban land use and improve the degree of concentration of urban land areas.

Based on the variation trends in urban population, urban land area and GDP in the PRDEZ from 1982 to 1990 and from 1990 to 2000, the ECUL and BCUL values were calculated for the entire study area and for each city in the PRDEZ (Table 3). The ECUL shows a decreasing trend from the earlier to the later period. From 1982 to 1990, while China was still at its initial stage of reform and opening up to the outside world, the PRDEZ was the frontier region for reform and opening up. In this period, a large number of industrial enterprises entered and settled in the various cities and districts in the PRDEZ, followed by construction of a many factories and plant houses and the rapid development of tertiary industry. As a result, land use for urban construction increased enormously. However, the increase in urban population has not kept up with the expansion in urban land area, so the value of ECUL is still relatively large. But this accords with the status of economic development at that time. From 1990 to 2000, the value of ECUL becomes smaller – 1.71 – and corresponds with the economic seedtime and urban development. In some cities, such as Shenzhen, Guangzhou, that had reached a relatively high level in terms of both economy and

urbanization, ECUL is below 1.0. This indicates that when there is some urban development, urban population agglomeration is better than urban development in terms of land use. Urbanization favors not only the full utilization of urban land area but also agglomeration of urban population. Therefore, urbanization was an important way to improve efficiency of urban land use.

Values of BCUL for the period from 1982 to 1990 are not calculated because GDP data are not available for 1982. But the agglomeration effect of urban development toward the economy can be expressed by the BCUL from 1990 to 2000 (Table 3). The BCUL for the whole PRDEZ is 1.9, indicating that social economic development is far faster than the increase in urban land area in the whole PRDEZ during the process of urbanization. The values of BCUL in cities that have very high urbanization are even higher. For example, the BCUL for Shenzhen was 6.671 from 1990 to 2000. Hence, urbanization is an effective way for economic agglomeration in urban areas.

CONCLUSIONS

By utilizing large amounts of data and three indices (coordination coefficient between cropland and urban land, expansion coefficient and benefit coefficient of urban land), the relationships between urbanization, cropland, population and economy were calculated. The results suggest that urban expansion occupies only a small part of the reduced cropland area. In most cities in the PRDEZ, the relationship between urban land increase and cropland decrease can be considered balanced, and the form of land use desirable. The results lead to the following conclusions:

1. With the improvement in economic development, the urbanization process of the study area is very rapid in the PRDEZ. However, urbanization is not the main reason for the cropland reduction.
2. Urbanization may lead to migration of large numbers of the rural population toward urban areas. This population migration might result in release of residential land from rural areas, hence the per capita cropland area of the agricultural population would be increased. Urbanization of the rural population can effectively alleviate pressure on agricultural land use by the ever-increasing agricultural population.
3. When urbanization develops to a certain extent, it is considered that attention should be drawn to the internal potential of urban land use during urban expansion. Urbanization would favour the improvement in the degree of intensification of land use.
4. Urbanization can help to boost the agglomeration effect on both population and economy. The economic benefit of land use would be increased during urbanization.
5. With the incessant increase in total population, the contradiction between 'more population and much less land' would become keener in the study area. Therefore it is necessary to improve the intensification degree of land use to solve this potential conflict. Urbanization is the most effective way to reach this goal. Consequently, the main task for the PRDEZ in the forthcoming period is to push forward the urbanization process.

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