China's Future Population and Development Challenges

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This paper is concerned with the consequences of population growth and rapid urbanization in China since the beginning of economic reforms. Detailed urban-rural and national population projections were carried out using an urban-rural population model. Three main challenges crucial to China's future development were identified in the light of the results. These are the agriculture-food challenge, the employment challenge and the urbanization challenge.

KEY WORDS: China, population growth, population projection, population and development.

C HINA HAS EXPERIENCED a dramatic decline in fertility since the early 1970s. The total fertility rate had been reduced from 5.75 in 1970 to 2.0 by 1992 (Peng, 1994). However, the population is still increasing owing to its particular structure and dynamics, and it is now clear that it may peak during the next 40 years, before entering a stable or declining stage. Hence there will be increasing population pressure in the near future.

Many scholars have already indicated several population problems facing China as a result of dramatic fertility decline and the tight implementation of family planning programmes. For example, the problems of rapid ageing of the population and the imbalanced sex ratio at birth have been recognized (Ogawa, 1988; Zeng et al., 1990; Hull, 1990; Johansson and Ola, 1991; Coale and Banister, 1994). The myth of sex ratio at birth is now being revealed (Gu and Roy, 1995): it reached a high mark of 112.3 in 1986, compared to a normal ratio of 107.4 in 1980, and this ratio was further increased to 114.1 in 1993. It has been found that the imbalance between male and female births occurs mainly among women who already have one or more children, but especially among women having daughters but no sons. Underreporting of births and sex-selective induced abortion have been identified as the main causes of this high ratio (Zeng et al., 1993), while female infanticide and abandonment also play some part.

This paper focuses not on the demographic issues mentioned above, but on the development implications of future trends. Notwithstanding the rapid economic growth in China in recent decades, there have been increasing concerns about the environmental, social and global consequences of such development. This paper will use an urban-rural projection model to estimate China's future population and then explore some fundamental challenges in the light of future trends. This may form a starting point for addressing the development problems and seeking practical solutions for sustainable development in further studies.

The paper is organized as follows: in the first section, basic issues of the population problem will be discussed; the urban-rural model and projection results will be examined in the next section, followed by a discussion of the challenges of rapid population growth and urbanization; and some conclusions are drawn in the final section.

China's population problem

China's population has experienced rapid growth since 1949, and it has been widely accepted that mounting population pressure has been a key factor affecting China's pace of modernization. Table I presents the population size of mainland China in selected years. There was a population of only 542 million at the end of 1949, but population reached 1200 million on 15 February 1995. Rapid growth makes it difficult to raise the people's living standard significantly. It is worth mentioning the worst case of population-food crisis, which took place over the three-year period 1959–1961, owing to the government's mismanagement and a series of natural disasters. Many people died owing to the food shortage during that period, and the population experienced a negative natural increase rate of −0.46 per cent in 1960 (Jowett, 1989; Shen, 1994). However, growth accelerated very soon after the crisis.

In response to this rapid growth, a series of stringent family planning programmes have been introduced, particularly in rural areas, since the early

1970s. The strongest and most controversial, the 'one-child' policy, was launched in 1978. This policy was based on a projection that the country's population would continue to grow for a long time if every couple had two children. Owing to such stringent policies, the total fertility rate was dramatically reduced from 5.75 in 1970 to 2.25 in 1990, according to the 1990 census (SSB, 1991).

Rising sex ratio at birth is one of the negative results of a tight family-planning policy, and illegal cases of female infanticide occurred in rural areas owing to the preference for male offspring (Coale and Banister, 1994; Gu and Roy, 1995). However, it is worth noting that the total fertility rate has never been pushed down below 2.0 in these years, and the total fertility rate would be much higher without these programmes. The tight policy has also been relaxed in the current reform period, especially since the early 1980s. Indeed, the sex ratio at birth is only high amongst women having at least one child, and the high sex ratio at birth for China as a whole has only occurred since 1986 (Gu and Roy, 1995). The positive effect of these family planning programmes is that about 200 million fewer infants were born over the period 1970–1995, considerably lessening the pressure: the current population would have been 1400 million instead of the actual 1200 million.

Nevertheless, China's population will continue to grow in the next 40 years as a result of its huge base of fertile population. It is well known that the dynamics are determined not only by the current levels of fertility, mortality and migration, but also by previous levels of these components of change, which effect the current age-gender structure. The higher fertility rates in the 1960s and early 1970s produced a large population group who are now at the child-bearing age. The extraordinarily high extent of this group will result in a growing population, even though the total fertility rate is below the replacement level of 2.1–2.2.

The problem is further complicated by the rapid urbanization process in recent years caused by a liberal migration policy and rising agricultural productivity. It appears that the huge problem previously hidden in the rural areas is now being shifted to the urban areas. Migration was tightly controlled by the government in the pre-reform period. This was effectively achieved by the use of residence registration, grain rationing, job allocation and housing control. Government policies regarding urbanization and migration have changed in the reform period: urbanization is now regarded as a positive process which can stimulate socio-economic development, and the control of rural–urban migration has been more or less relaxed (Yan, 1991; Shen, 1996). In 1984, the State Council issued a document that allows peasants and their families to get permanent registration in towns and townships as long as they conduct industrial

or commercial activities. Peasants are also allowed to obtain temporary registration in small and medium-sized cities. Migration to big cities remains tightly controlled. Furthermore, construction projects in urban areas have attracted many rural migrants.

As a result, the scale of rural–urban migration has increased dramatically since the late 1970s, though the process is complicated and sometimes confusing (Shen, 1995). For example, China is often cited as having a 'floating population' of over 100 million, which includes visitors staying for over three days. It is difficult to estimate how many of them can be defined as migrants but it does indicate the potentially huge pressure for rural–urban migration.

Thus the problem has not only resulted from population growth but also from a rapid rural–urban population shift. Urbanization particularly will become an increasingly important issue as the national growth rate gradually slows in the future. This paper uses an urban-rural population model to project future growth, rather than a single national projection. The impact of urbanization on future development can be examined using such an urban-rural population framework.

China's future population projections

China's population has experienced rapid growth in the last four decades. What is the likely future of population in China? As was pointed out in the previous section, the main problems facing China in the future are not just its increasing population, but the rapid urbanization which will demand greater use of natural resources, urban land, housing, employment and education. It would be most useful to make a systematic long-term projection using an urban-rural population framework.

An urban-rural model has been established, which is essentially a multi-regional cohort-survival population model, based on refined forward demographic rates and extended population accounts (Shen, 1994). These methodological developments are useful to define precise demographic rates and to make spatial population projections more straightforwardly. Many previous spatial models are unable to define correct demographic rates and often involve a complicated procedure for parameter estimation or projection.

Another important development is the adoption of a demo-economic model. Changing migration rates linked with the economic process have been introduced into the model instead of the usual constant migration rates. The urban-rural model used in this paper is not just a demographic model but really a spatial demographic-economic model.

In the demo-economic model of rural–urban migration, it is assumed that the demand and supply of urban and rural labour are balanced in the process of industrialization and urbanization.

TABLE I

Population in mainland China, 1949–1995 (million)

Year	Population
1949	542
1954	600
1964	700
1974	900
1981	1000
1988	1100
1995*	1200

* 15 February 1995. Other figures are year-end.

TABLE II

Urban and rural population projection for China

Year	Urban (m)	Rural (m)	China (m)	Urban (%)
1988	334.40	766.44	1100.84	30.38
1990	367.40	768.51	1135.91	32.34
1995	450.04	778.57	1228.61	36.63
2000	530.51	781.49	1312.00	40.44
2010	702.50	725.12	1427.61	49.21
2020	875.66	654.56	1530.22	57.22
2030	1015.66	578.95	1594.61	63.69
2040	1122.59	481.01	1603.60	70.00
2060	1233.56	306.86	1540.42	80.08
2087	1218.53	151.02	1369.55	88.97

Rural–urban migration is 'pushed' by rising agricultural productivity and 'pulled' by the increasing demand for the industrial products and services with the rising income of the national population. The four main parameters in the demo-economic model are the growth rates of productivity and the income elasticity of consumption of the products in the urban and rural sectors. The average parameters for the period 1979–1988 were used for baseline projections. It would be possible in the model to simulate other scenarios using different values of these parameters. For example, China's urbanization level in the year 2040 could range from 71.3 per cent in the baseline projection to 36.8 per cent in a specific simulation that assumes slower growth in agricultural productivity. The model has been discussed elsewhere in detail (Shen, 1994; Shen and Spence, 1996). Figure 1 presents the urban-rural system and how this has been modelled. There are three components of population change: the death components are modelled using age-gender specific mortality rates; the birth components are modelled using normal age-gender specific fertility rates and total fertility rates. As mentioned previously, rural–urban

migration is modelled by a demo-economic migration model.

The main data inputs of the urban-rural population projection are the age/gender-specific data, and mortality, fertility and migration rates for the urban and rural populations respectively. All these demographic rates have been estimated in earlier research (Shen, 1991). Three sets of projections have been made assuming different fertility rates in urban and rural areas. However, only the first set of projections, which assumes constant urban and rural total fertility rates, will be discussed here. The total national fertility rate will still decline, with an increasing proportion of the urban population having a lower total fertility rate than the rural population.

1987 has been used as the base year for these projections. The projections of urban and rural populations depend on how these populations are defined. Several definitions exist in official statistics and in the literature (Shen, 1995). In these projections, a slightly modified definition based on the actual urban non-agricultural employees, yet close to the definition used in the 1991 census, was used (Shen, 1994).

Table II and Figure 2 present the projected urban and rural populations and the percentage of urban population over the period 1988–2087. According to Table II, China's population will increase from about 1229 million in 1995 to 1604 million by 2040. About 400 million will be added to the current huge population, though the other two alternative projections give slightly lower growth over the same period (Shen and Spence, 1996). Population may decline over the period 2040–2087, giving a total population of 1370 million in 2087.

Despite urbanization and rural–urban migration, the size of the rural population will continue to increase until 2000, reaching 781 million. Then it will begin to decline in the early 21st century, from 781 million in 2000 to 481 million by 2040. Only 151 million will remain in rural areas by 2087.

The urban population will expand rapidly from 450 million in 1995 to 1123 million by 2040, and continue to grow until 2060. It will then decline slightly from a peak of 1234 million, to 1219 million
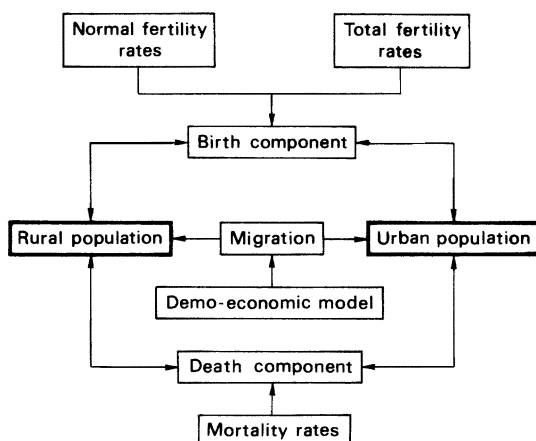

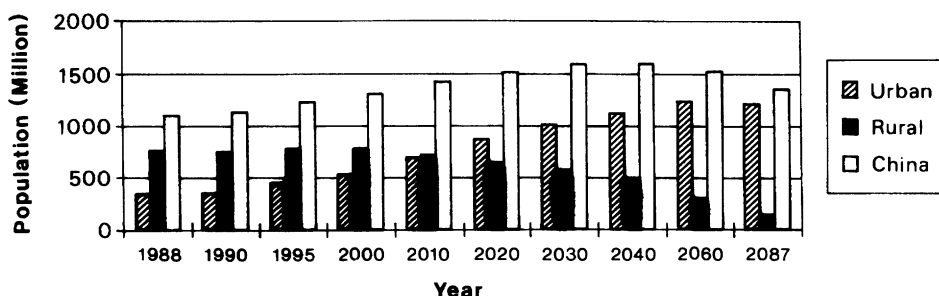*Fig. 1. The urban-rural population model*

Fig. 2. Urban and rural population projection for China, 1988–2087

by 2087. The percentage of Chinese people living in towns and cities will rise from 37 per cent in 1995 to 70 per cent by 2040, and 89 per cent by 2087.

The size of the working population (females aged 18–59 years and males aged 18–64 years) is closely related to the labour market and the employment pressure. Table III and Figure 3 present working population projections in urban and rural areas. For China as a whole, this will increase from 732 million in 1995 to 955 million by 2020, and then decline slightly to 801 million by 2087.

The rural working population reached its peak in 1995 and will then decline to 267 million in 2040 and only 84 million by 2087. The urban working population will show a very rapid increase over the period 1995–2020. It will rise from 286 million in 1995 to 570 million in 2020, and will continue to increase, reaching 733 million by 2060. Then it will decline slightly to 717 million by 2087.

Rapid fertility decline in the past two decades may result in a severe population ageing problem. Table IV and Figure 4 present the projections of elderly population proportions (females aged 60+ years and males aged 65+ years) in urban and rural areas. For China as a whole, the proportion of elderly population will increase rapidly from 8.01 per cent in 1995 to 18.18 per cent by 2040 and then continue to increase slowly. For the rural population, this proportion will increase from 8.09 per cent in 1995 to 16.18 per cent in 2040, and then experience a slight decrease at the end of the time period under study. The initial proportion is smaller in urban areas than in rural areas but it will increase much more rapidly in urban areas over the projected period. It will increase from 7.87 per cent in 1995 to 19.04 per cent in 2040 and continue to increase, reaching 21.58 per cent in 2087. By the end of the period, the urban population will have a much higher proportion of elderly residents than the rural population.

The above projections provide a clear picture of the future population. They have profound implications for socio-economic development in China as well as in the world. Some of them will be discussed in detail in the next section.

Population and development challenges

Two major phases of future population growth can be identified with an apparent division around 2040. In the phase before 2040, the population will continue to grow and China will face a rapid increase in its labour force, rapid urbanization and rapid population ageing. Four great challenges will be faced during this stage:

an agriculture-food challenge;
an employment challenge;
an urbanization challenge; and
a population ageing challenge.

In the second phase, after 2040, the population will begin to decline or stabilize, the focus then being on improving the living standards without further expansion. There have been many other discussions on the issue of rapid population ageing in China (Ogawa, 1988; Zeng *et al.*, 1990); this paper will focus only on the first three main challenges.

Agriculture-food challenge One of the major problems for China is to produce sufficient grain for its expanding population. Table V presents the grain production per capita over the period 1950–1994 and the estimated production required if the level per capita is maintained as in the year 1994. Generally, grain production has been increasing steadily since 1950, as well as production per capita. The total production increased from 132.13 billion kilogrammes in 1950 to 446.24 billion kilogrammes by 1990, and the production per capita increased from 239 to 390 kilogrammes over the same period. There were two exceptions: firstly, the grain production reached a lower level in 1960 (217 kg, even lower than that of 1950) than preceding years owing to a series of natural disasters and errors in administration and economic policy; secondly, production during recent years was unable to achieve steady growth, and fluctuated around a total of 450 billion kilogrammes, with 1995 being an exceptionally high year (480 billion kg). The fluctuation of grain production poses a real challenge as the population continues to grow over

TABLE III

Working population projection for China, 1988–2087 (million)

Year	Urban	Rural	China
1988	206.74	425.69	632.43
1990	231.72	435.80	667.52
1995	286.21	446.21	732.42
2000	335.70	442.83	778.53
2010	456.01	422.91	878.93
2020	570.11	385.31	955.42
2030	624.99	325.13	950.13
2040	675.69	267.46	943.15
2060	732.54	170.00	902.54
2087	716.95	83.86	800.82

the next 40 years. An official target of 500 billion kilogrammes in the year 2000 has been set.

According to the above projection, China's population will increase by 375 million over the period 1995–2040, the current total population of the United States and Japan. If China maintains grain production per capita at its 1994 level, then the total will need to reach 568 billion kilogrammes by 2020 and 595 billion by 2040 (the normal level in 1994 rather than 1995 was used for estimating the minimum requirement for the future). The population will increase annually by 8.33 million over the period 1995–2040, requiring an annual increase in grain production of 3.09 billion kilogrammes. In reality, annual population growth will be much greater over the period 1995–2020, and on average will increase by 12.06 million per year in that period, hence the annual increase in grain production needs to be 4.47 billion kilogrammes.

Will China be able to meet this challenge? Several factors need to be considered. Over the period 1984–1994, grain production increased by 3.75 billion kilogrammes per year, a sum greater than the estimated annual increase over the period 1995–2040, but much smaller than the required annual increase over the period 1995–2020. Technical progress may help to augment grain production, but the decline in arable land may reduce the effects of this technical

progress. It may be difficult to maintain the annual growth in production achieved previously. The amount of arable land in China has been disputed for many years. A recent survey of land resources showed that arable land totals 133 million hectares (*People's Daily*, 1996), which is much greater than the 1994 official figure of 95 million hectares. However, this does not mean that there is now more arable land than in 1994. It simply provides a more precise figure of the land resources. Furthermore, the arable land per capita is still less than 50 per cent of the world average. Recent statistics, presented in Table VI, show that arable land is being lost at an increasing rate owing to construction, natural disaster and other causes (SSB, 1996). In the year 1995, a total of 0.62 million hectares of arable land were lost, of which 0.39 million were owing to natural disasters and other causes. Urban, housing and other constructions are consuming more and more arable land: the land lost annually to state construction projects increased from 0.07 million to 0.11 million hectares over the period 1991–1995. Part of the lost land is being compensated for by newly-acquired land. The net loss of arable land is about 0.33–0.40 million hectares a year according to one recent estimate (*People's Daily*, 1996), reducing grain production capacity by 2–2.5 billion kilogrammes per year.

China may import grain from the international market to meet part of the domestic demand. However, it is well known that the major grain producing countries and companies are keen to control agricultural production to maintain/increase grain prices. The total volume of international trade has been fluctuating around 200 billion kilogrammes per year. Grain may be regarded as a strategic product and dependency on foreign grain production will severely undermine national security. Thus, China has been very careful about increasing grain imports and is seeking rather to increase her domestic production. Great efforts must be implemented to improve agricultural technology and land resources management.
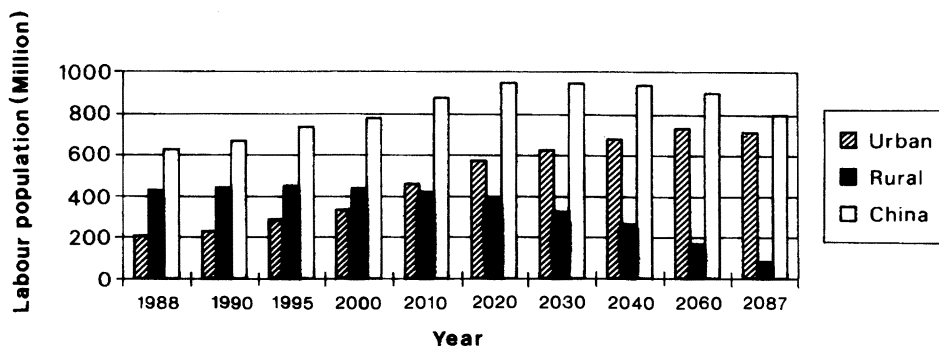

Fig. 3. Urban and rural working population projection for China, 1988–2087

TABLE IV

Projection of the elderly population proportion for China, 1988–2087 (%)

Year	Urban	Rural	China
1988	6.99	7.16	7.1
1990	7.25	7.48	7.4
1995	7.87	8.09	8.01
2000	8.43	8.48	8.46
2010	9.34	9.36	9.35
2020	12.12	11.55	11.87
2030	16.10	14.12	15.38
2040	19.04	16.18	18.18
2060	20.23	16.04	19.40
2087	21.58	15.94	20.96

Employment challenge Employment is one of the main indicators of economic performance, and is also closely related to income distribution, welfare expenditure, poverty and social stability. The majority of the population relied upon a self-subsistence agricultural economy before the 1980s, though the state sector dominated the industrial sector. However, the income and living standards of the rural population based on such an agricultural economy were very low, and there was also a large number of surplus rural labourers not fully utilized. It has been estimated that 40 per cent of rural labourers were under-employed and needed to be redeployed to non-agricultural sectors (Taylor and Banister, 1991; Shen and Spence, 1995). Recent development of township industries and rural–urban migration provided many employment opportunities. The total number of employees in the township and village enterprises increased from 28 million in 1978 to 129 million by 1995 (SSB, 1996). Only a small proportion of them (3.1 million in 1995) were engaged in agricultural production, whilst the total number of non-agricultural employees was 294 million. This means that nearly 50 per cent of all non-agricultural employees are now in township industries. Nevertheless, agriculture remains the largest employment sector, with 330 million employees in 1995,

showing only a slight decline from its 1991 peak of 349 million, giving a residue of over 100 million under-employed persons in rural China.

The official unemployment statistics do not include those unemployed/under-employed in the rural areas. Increasing competition from township industries and foreign investment companies has rendered many state-owned enterprises unprofitable in the reform period. It is noted that the state-owned sector is the largest urban employer, with over 113 million people, accounting for 64.9 per cent of all urban employees in 1994. Many employees have been made redundant and the number of unemployed had increased from 2.39 million in 1985 to 5.20 million by 1995 (SSB, 1996). The unemployment rate had also increased from 1.8 per cent to 2.9 per cent over the same period.

Considering the projected increase in the working population, the immense employment pressure is very clear. The working population will increase from 732.42 million in 1995 to a peak of 955.42 million by the year 2020. This is a 30 per cent increase in just 25 years, giving a net increase of 232 million labourers. Considering that all of these will need to be employed in the urban sector, the employment challenge is much greater. According to the projection given in the previous section, the working population in the urban areas will increase from 286.21 million in 1995 to 570.11 million by 2020, doubling the current urban sector in 25 years. Such a massive increase in the supply of labour to the urban market poses severe problems. Nevertheless, it also provides a great opportunity for investors to make use of such a large quantity of cheap labourers. A large population will form a large consumer market if investment, production, distribution and consumption can be well integrated.

Urbanization challenge Rapid industrialization will be accompanied by a dramatic rural–urban population shift. With the increasing national population, the scale of urban development will be immense.
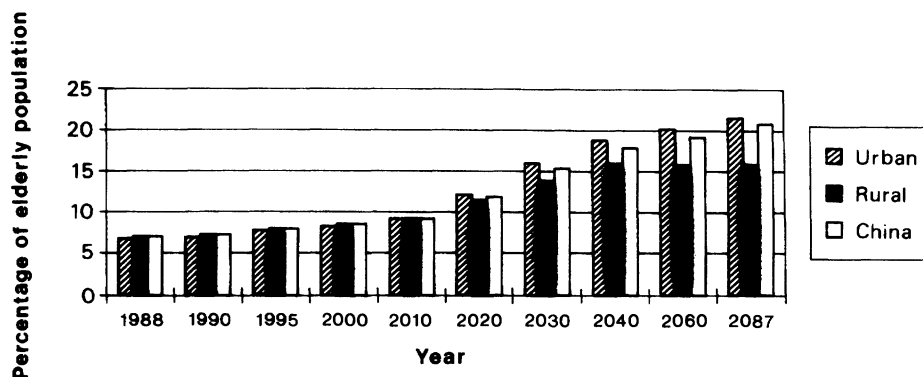

Fig. 4. Urban and rural elderly population projection for China, 1988–2087

TABLE V

Grain production per capita in China

Year	Population (m)	Grain production (billion kg)	Grain production per capita (kg)
1950	551.96	132.13	239
1960	662.07	143.50	217
1970	829.92	239.96	289
1980	987.05	320.56	325
1990	1143.33	446.24	390
1994	1198.50	444.60	371
2000*	1312.00	486.75	371
2020*	1530.22	567.71	371
2040*	1603.60	594.94	371

* Estimated projection by the author.

Source: SSB, 1991; DPES and DMPS, 1996

TABLE VI

Decrease of arable land in China, 1991–1995 (000s hectares)

Year	1991	1992	1993	1994	1995
State capital construction	71.9	131.7	161.0	132.6	111.9
Rural collective construction	33.4	64.1	86.0	80.2	84.9
Rural private construction	20.5	23.9	24.0	33.0	31.6
Natural disaster and other causes	362.2	519.0	461.3	462.9	392.7
Total	488.0	738.7	732.3	708.7	621.1

Source: SSB, 1996

The pace of urbanization was very slow before the late 1970s compared with other developing countries (Shen, 1994): the percentage of urban population was 11.2 in 1950, and still only 17.9 by 1978. This low level of urbanization resulted from deliberate policies of controlling rural–urban migration and urban growth. Economic reforms have since speeded up the industrialization and urbanization processes (Chan, 1994). A large number of towns and cities have emerged, while old cities are rapidly expanding their administrative areas. The number of towns increased from 2819 in 1982 to 17 282 by 1995, and the number of cities from 191 in 1978 to 640 by 1995 (SSB, 1996). Shanghai increased its urban area from 141 to just over 230 square kilometres by establishing two new urban districts, Wusong in 1980 and Minhang in 1982, and to 350 square kilometres by the expansion of existing districts. The establishment of Pudong new districts in April 1990 added some 350 square kilometres to the urban area of Shanghai, providing more development space for China's leading economic centre. For China as a whole, the urban population has doubled over the period 1978–1995, and the percentage living in urban areas has risen to 29.0.

However, the dramatic expansion of the urban population over the past 16 years is just the beginning of a massive stage of expansion. Owing to natural increase and the rural–urban shift, the urban population will increase from 450 million in 1995 to 1123 million by 2040. The percentage of urban population will be raised to 70 per cent by the year 2040. As the largest country in the world, such a scale of urbanization will have major implications for national as well as international development. A strategy of sustainable development needs to be adopted and the natural resources and environment must be managed efficiently and carefully.

In fact, rapid urbanization has already resulted in the decline of arable land available and essential to keep pace with the population growth. As major population and urban centres are usually located in the centre of the best arable land, this decline is at an alarming rate of 0.3–0.4 million hectares a year owing to increasing residential, industrial and urban land use. Currently, urban and rural settlements cover a total area of 18 million hectares. Among these, rural villages and town settlements use 16 million hectares. The land use in small settlements is managed by various local governments, though many residents living in villages and towns tend to use more land for housing than stipulated. This is particularly so when income is rising and the proportion of agricultural income is declining. There is an urgent need to review the process of land management and to control the transfer of agricultural land to other uses. The urbanization strategies based on large, medium or small cities or towns also need to

be evaluated from the land-use perspective and for the protection of arable land and environment. An urbanization strategy based on a medium-sized city may make significant savings in land and also avoid the severe problems of large cities (Shen, 1994).

Conclusion

This paper has examined the changing patterns of population and development in China. Two main aspects of the population problem, namely growth and urbanization, have been discussed. It has been emphasized that the anticipated rapid rural–urban shift will be a major problem facing China's future development. An urban-rural population framework has been adopted to model the future of national and urban-rural growth, and the results of long-term urban-rural and national projections discussed. These results are most useful for providing a broad picture of what will happen in the urban and rural areas and the implications for agricultural production, food supply, employment and urbanization. Three major challenges have been identified and examined in detail.

As China's population will increase by 375 million over the period 1995–2040, there will be an urgent demand for increased grain production, considering that arable land is declining by 0.33–0.40 million hectares per year. Production must be increased by at least 4.47 million kilogrammes per year over the next 25 years to keep up with the growing population (this estimate is based on a constant production per capita level in the year 1994 and is already much greater than what was achieved over the period 1984–1994). Significant technical progress in agriculture and efficient conservation of arable land must be achieved to face this great agriculture-food challenge.

China currently has over 100 million surplus rural labourers and 5.2 million urban unemployed persons.

Expanding township industries have already absorbed about 130 million rural labourers, but the number of urban unemployed persons has been increasing owing to the introduction of market mechanisms and the closure of many state-run loss-making enterprises. It is expected that the labour force will be further expanded by 30 per cent in the next 25 years. Considering the urbanization process and the rural–urban population shift, the labour supply in urban China will be doubled over the same period. Rapid economic growth must be sustained to ensure a low unemployment rate, in order to prevent an unstable society.

The urbanization process has already speeded up since the late 1970s. Urban population has doubled over the period 1978–1995, and an even more massive expansion is expected in the next 45 years, potentially reaching 1123 million. Such rapid urbanization will have major implications for construction, development and the use of natural resources.

This paper has used an urban-rural spatial framework. It would be of interest to examine the population and development issues on a finer spatial scale such as at the provincial level, and such analysis may become the focus of future research. Recent trends in regional development indicate that major economic growth is taking place in coastal regions, which have become the destination of many migrants (Shen, 1996). The growth of three metropolitan areas, namely the Zhujiang delta region, the Changjiang delta region and the Beijing, Tianjin and Tangshan region, could be potentially phenomenal.

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