Research Note

China's Agricultural Land

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Official figures show that the total extent of China's farmland has been steadily decreasing since the late 1950s and that it now stands at roughly 95 million hectares (Mha).[1] Divided by 1.243 billion people, China's mid-1998 population total, this prorates to less than 0.08 ha/capita, a rate comparable to that of Bangladesh, equal to only about 60 per cent of Asia's and to roughly 40 per cent of India's mean, and to just 25 per cent of the global average (Figure 1).[2]

This scarcity of agricultural land is a source of great concern in a country which, in spite of its low relative population growth rate, still adds 12–13 million people a year and whose rapid economic modernization has brought several-fold increases of average per capita consumption of animal foodstuffs, aquatic products, plant oils and fruits.[3] Not surprisingly, this farmland scarcity and the continuing decline of cultivated area have been among the key arguments of Lester Brown's well-publicized "wake-up call" about China's capacity to feed itself during the coming generation.[4] But the official figures, putting China's national per capita mean of arable land below the Bangladeshi average, are wrong.

While aggregate figures of this kind are rarely accurate, the official total of China's farmland is about 50 per cent lower than the real figure. No less remarkable is the fact that the approximate extent of this underestimate has been known to informed Chinese experts, as well as to some Western scholars, for nearly two decades. Moreover, disaggregated statistics on farmland losses demonstrate that the decline has been the result mostly of desirable land use changes rather than of regrettable disappearance of farmland underneath new cities, industries and transportation links. None of this means that the long-term prospects of

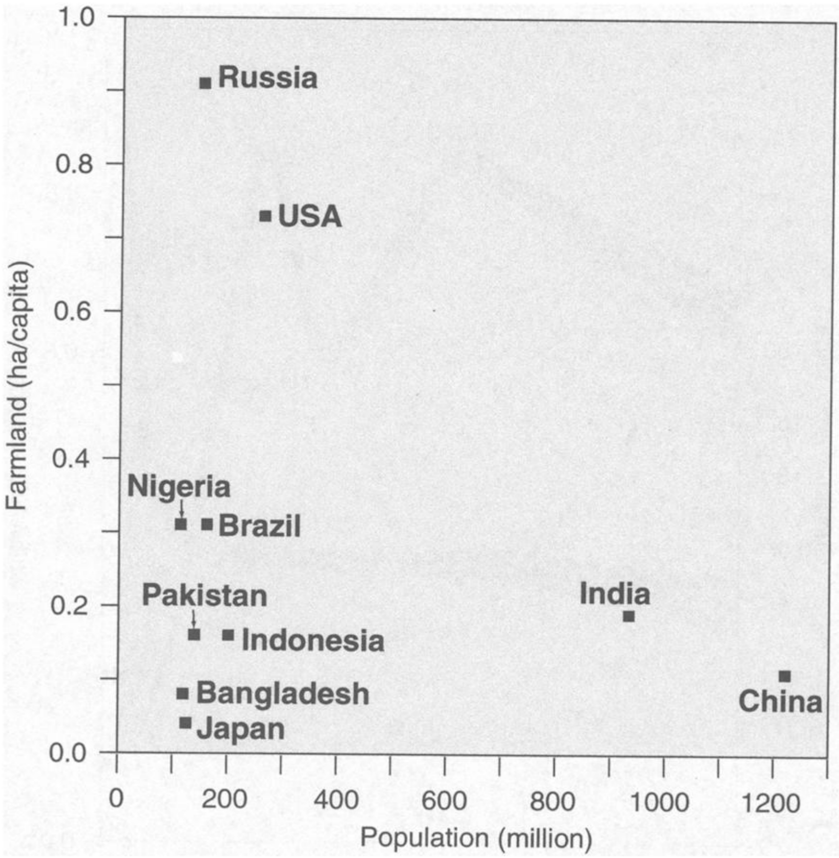
1. The two annual Chinese sources are *Zhongguo tongji nianjian* (*China Statistical Yearbook*) (Beijing: Zhongguo tongji chubanshe), and *Zhongguo nongye nianjian* (*China Agricultural Yearbook*) (Beijing: Nongye chubanshe). Official Chinese data are regularly reprinted in Food and Agriculture Organization (FAO), *Production Yearbook* (Rome: FAO, annually), and in World Resources Institute, *World Resources 1996–97* (New York: Oxford University Press, biennially).

2. As all of these figures come from official national statistics collated by the FAO there is no doubt that real values for many poor populous countries may be appreciably different.

3. For more on China's nutritional transition see: Barry M. Popkin *et al.*, "The nutrition transition in China: a cross-sectional analysis," *European Journal of Clinical Nutrition*, Vol. 47 (1993), pp. 333–346; Vaclav Smil, "Feeding China," *Current History*, Vol. 94, No. 593 (1995), pp. 280–84.

4. Lester Brown, *Who Will Feed China?* (New York: W.W. Norton, 1995). For critiques of Brown's arguments see, among oth Vaclav Smil, "Who will feed China?" *The China Quarterly*, No. 143 (1995), pp. 801–813; Jiang Wandi, "China poses no threat to future global food supplies," *Beijing Review*, Vol. 38, No. 5 (30 January–5 February 1995), pp. 14–16; Scott Rozelle *et al.*, "Why China will not starve the world," *Choices*, No. 1 (1996), pp. 18–25; Nikos Alexandratos, "China's projected cereals deficits in a world context," *Agricultural Economics*, Vol. 15 (1996), pp. 1–16.

Figure 1: **Mid-1990s Per Capita Farmland Availability in the World's Most Populous Countries**



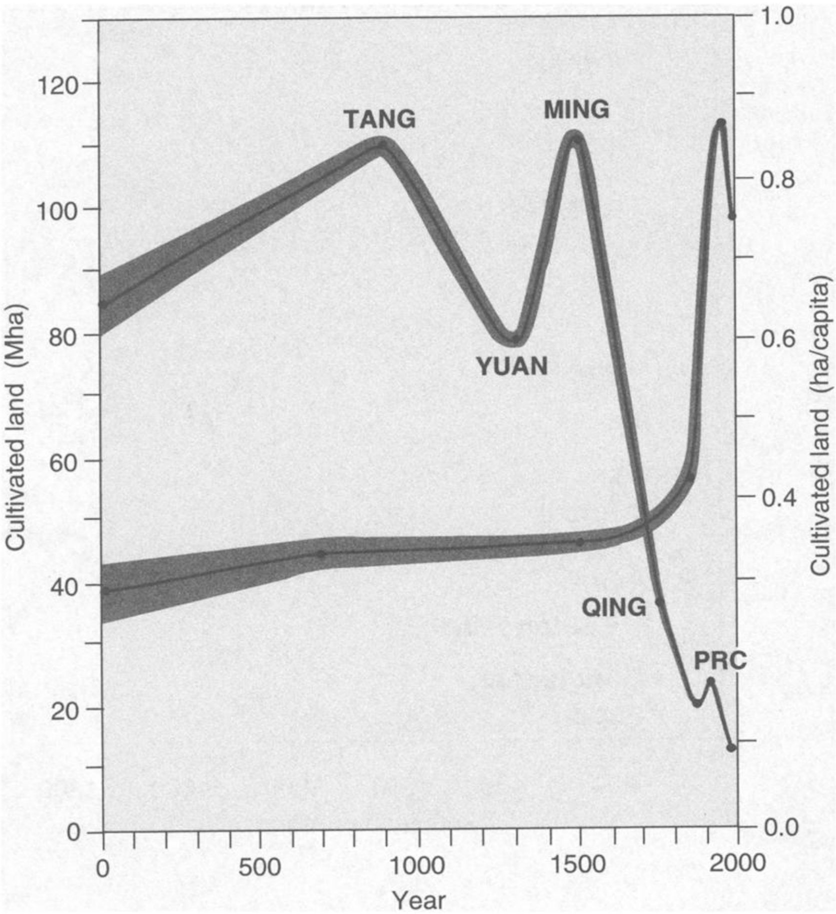
China's food production should not be a matter of concern – but starting with correct data is an essential precondition of an informed appraisal of challenges facing the world's largest population as it moves towards its asymptote of some 1.5 billion people to be reached before the middle of the 21st century.[5]

Official Farmland Statistics: A History of Underestimates

The best available historical reconstruction must be seen merely as an indicator of trends: it shows the total of some 40 Mha during the Han dynasty followed by 17 centuries of fluctuations and then more than a century of steady expansion during the late Qing followed by even faster

5. The latest long-term population projections are available in United Nations, *World Population Prospects: The 1996 Revision* (New York: United Nations, 1998).

Figure 2: **Reconstruction of China's Total and Per Capita Farmland Availability**



additions during the first half of the 1950s (Figure 2).[6] In per capita terms these trends correspond to availabilities of 0.60–0.85 ha between the Han and the Ming, a drop to about 0.14 ha during the late Qing and then a rise to 0.17 ha by the mid-1950s.

Official PRC statistics began with a very precise total of 97.881 Mha for 1949 and were interrupted, as with the rest of regular data reporting, at 111.83 Mha in 1957.[7] Regular publication of cultivated land totals resumed in 1978 with the figure of 99.389 Mha; by 1990 the total

6. This reconstruction is based on the data in: "China's population, land, grain," *Zhongguo renkou bao* (*China Population Newspaper*), 31 March 1989, p. 1.

7. All available figures are compiled in Frederick W. Crook, *Agricultural Statistics of the People's Republic of China, 1949–86* (Washington, D.C.: U.S. Department of Agriculture, 1988).

declined to 95.673 Mha and it was 94.97 Mha in 1995.[8] This means that the official per capita means are now below one *mu* (that is less than 667 m^2) in one-third of all provinces, with the lowest rates in southern coastal provinces averaging less than 500 m^2.

For an uninitiated user the only indication that these official figures are suspect comes in small print at the bottom of the State Statistical Bureau's (SSB) land use table which notes that the figures "obtained from statistical checks during previous years ... are subject to further verification." But knowledgeable Chinese and interested foreign observers have always known that these official figures understate the actual total of China's cultivated area.

China has a long history of under-reporting its grain area, and these practices continued after 1949.[9] Widespread use of non-standard *mu* for area measurements has been a long-standing source of uncertainty.[10] Motives to under-report in communal farming were obvious: less reported land meant lower state production quota and reduced taxes – but a commune's leadership could use output from the unreported land to inflate the average yields and hence set new harvest records and be accordingly rewarded by red flags, banquets or trips to the capital. We will never know how widespread this undoubtedly common "helping field" phenomenon was before the privatization of the early 1980s.

Incentives to under-report are no less strong in privatized farming. To begin with, the initial division of land among peasants often recognized the inherent differences in land quality and, in order to equalize such disparities, multiples (commonly between 1.25 and 1.5) of less productive slopeland would be credited in registers as one *mu* of more productive farmland. Under-reporting of grain land also meant lower quota of cereals that had to be delivered to the state at the fixed price, and what is perhaps the most powerful incentive remains even after freeing agricultural prices: hiding land reduces taxes.[11] While recognizing these facts, many bureaucrats in Beijing argued that "since there is no overwhelming reason to assume that the overall extent of inaccuracy has changed significantly during the last 30 years, the *trends* are not affected by this problem."[12]

8. For details on recent official totals of arable land and on reported loss and reclamation rates ➡ Robert F. Ash and Richard L. Edmonds, "China's land resources, environment and agricultural production," *The China Quarterly*, No. 156 (December 1998), pp. 836–879.

9. Frederick W. Crook, "Underreporting of China's cultivated land area: implications for world's agricultural trade," in *China Situation and Outlook Series* (Washington, D.C.: U.S. Department of Agriculture, 1993), pp. 33–39.

10. *Mu* (divided into 10 *fen*, each of them into ten *li*) equals 1/15 of a hectare, or 666.667 m^2. But in some parts of China *mu* may be as large as 1,131 m^2 – or as small as 532 m^2: Xinhua, 28 December 1987, *BBC Summary of World Broadcasts*, FE/W807 A/1.

11. Of course, China is far from unique in this regard: under-reporting of farmland has been widespread in most agrarian societies. The greatest disparity I have come across resulted from an ongoing cadastral survey of Nepali hills: it revealed that the cultivated area of the region is almost four times as large as shown by the official decennial National Agricultural Census figures, with subregional multiples ranging from more than two to more than eight: Gerard J. Gill, *O.K., The Data's Lousy, But Its All We've Got (Being a Critique of Conventional Methods)* (London: International Institute for Environment and Development, 1993).

➡ Kenneth R. Walker, "Trends in crop production, 1978–86," *The China Quarterly*, No. 116 (1988), p. 593.

Table 1: **Estimates of China's Farmland Based on Satellite Image Studies and Land Surveys, 1980–96**

Year	*Mha*	*Source*
1980	135.8	National Centre of Remote Sensing
1980	143.3	National Agricultural Commission
1980	132.5	Second General Soil Survey
1985	138.6	Commission for Integrated Survey of Natural Resources CAS
1985	139.7	State Land Administration Bureau
1985–90	133.8	State Land Administration Bureau Detailed Land Use Survey
1990	131.2	Chinese Academy of Sciences
1990	137.3	Institute of Applied Remote Sensing CAS
1994	136.4	Wu and Guo
1994	133.3	Sun *et al.*
1995	131.1	State Land Administration Bureau
1996	133.3	*Renmin ribao*
1996	134.4	State Land Administration Bureau

Sources:
Bruce Stone, "The use of agricultural statistics," in Randolph Barker and Radha Sinha (eds.), *The Chinese Agricultural Economy* (Boulder: Westview Press, 1982), pp. 205–245; Dirk Betke D. and Johannes Kuchler, "Shortage of land resources as a factor in development: the example of the People's Republic of China," in Bernhard Glaeser (ed.), *Learning from China?* (London: Allen & Unwin, 1987), pp. 85–107; Wang Tong *et al.*, *An Economic Analysis of the Progressive Decrease in the Quantity of China's Cultivated Land* (Beijing: Jingji kexue chubanshe, 1992); Kang Xiaoguang, *Comprehensive Research on the Issue of China's Current Economic Development* (Beijing: Publishing House of Chinese Science and Technology, 1994), pp. 152–53; Chen Baiming, "Comments on 'Who will feed China?'" *Journal of Natural Resources*, Vol. 11 (1996), pp. 210–15; Gerhard K. Heilig, "Anthropogenic factors in land-use change in China," *Population and Development Review*, Vol. 23, No. 1 (1997), p. 142; State Land Administration Bureau, *Zhongguo tudi nianjian* (*China's Land Yearbook*) (Beijing: Zhongguo tudi chubanshe, 1997).

New Chinese Farmland Totals: Remote Sensing and Land Surveys

The first generalized mapping of China's land use completed by Wu Chuanchun in 1980 added up to 139.3 Mha of cultivated land (including 49.4 Mha of paddies), a total nearly 40 per cent higher than that year's official figure.[13] Similar totals – between 133 and 143 Mha of farmland as of the early 1980s – were offered later during the decade by analysing LANDSAT satellite images and by completing a second nation-wide soil survey (Table 1).

Two problems have made it difficult to come up with reliable farmland estimates based on LANDSAT satellite images. LANDSAT's low scanning resolution (80 m for the first generation of these satellites, 25 m for later designs) is sufficient for reliable mapping of the huge fields of North America's interior but it hides too much of the common small-scale

13. Wu Chuanchun, "Land utilization," in Qu Geping and Woyen Lee (eds.), *Managing the Environment in China* (Dublin: Tycooly International, 1984), p. 68.

variation typical of China's complex land-use patterns, particularly in southern provinces. And discriminating among various vegetated surfaces with similar spectral signatures – cropfields, uncultivated oddland, grasslands, woodlands, wetlands – is difficult, and often impossible, without a great deal of accurate ground information.[14]

While LANDSAT studies clearly demonstrated that China has considerably more farmland than officially admitted, only new land surveys could provide their satisfactory verification. Detailed land use surveys completed by the State Land Administration Bureau between 1985 and 1990 ended up with the total of 133.8 Mha – but there are good reasons to suspect that this still erred on the low side. In 1989 an official in the State Land Administration Bureau thought that its results – showing the actual area usually 20–30 per cent higher than the originally reported figures – must be suspect "since some local authorities did not want to provide accurate data, and were afraid that accurate statistics of farmland would lead to an increase in the agricultural tax and the grain procurement quota."[15]

All other figures published in Chinese sources or quoted by Chinese researchers and officials during the 1990s fit into a relatively narrow range between 131 and 137 Mha. In addition, a IIASA study – done with Chinese co-operation and using land survey data for 1985 to correct the official claims of total cultivated area – ended up with 137.1 Mha for the year 1995.[16] Consequently, there appears to be a fairly good Chinese consensus that the country had no less than 130 Mha of arable land as of the mid-1990s, or at least 36 per cent more than the official claim. The absolute difference of some 35 Mha surpasses the official farmland total for Indonesia or a combined total for France and Germany (about 31 Mha in both instances).[17]

Confirming a Higher Farmland Total: MEDEA Study

Assessment of China's cultivated land has been just one of several recent studies conducted by MEDEA, a multi-disciplinary scientific programme using information gathered by the U.S. intelligence organizations to answer a variety of questions concerning the Earth's environment.[18] Information from the *Keyhole* (KH) series of intelligence satellites, whose latest models (KH-11) return images with resolution of 15 cm or better, is a perfect tool for reliable land use mapping – but given the size of China's territory it would be both impractical and very

14. This task is particularly challenging in areas where ponds and small lakes, clogged with water weeds and supporting a rich growth of reeds, are mixed with paddy fields and groves of bamboo, mulberries or fruit trees.

15. Quoted in *Renmin ribao* (*People's Daily*), 31 July 1989, p. 2.

Gerhard K. Heilig, "Anthropogenic factors in land-use change in China," *Population and Development Review*, Vol. 23, No. 1 (1997), p. 142.

17. These are strictly quantitative comparisons lacking any adjustment for considerable difference in typical soil quality.

18. For origins and activities of MEDEA programmes see Jeffrey T. Richelson, "Scientists in black," *Scientific American*, Vol. 278, No. 2 (1998), pp. 48–55.

expensive to resort to a general high-resolution mapping. Instead, the study used a stratified, multi-stage area estimation approach, whereby samples of the higher resolution classified imagery were used as surrogates for *in situ* data to correct estimates derived from much coarser commercially available images, including Advanced Very High Resolution Radiometer and LANDSAT.[19]

This approach yielded a nation-wide mean of 143.3 Mha for the year 1992; with variation of 5.6 per cent at the 0.95 confidence interval the actual area could have been as low as 135.4 and as high as 151.4 Mha. This estimate was subsequently revised to the range of 133–147 Mha for the year 1997: failure of the initial appraisal to account properly for fallowed land and intervening conversions of farmland to non-agricultural uses were the main reasons for the reduction. These results provide a strong confirmation of previous Chinese claims of substantially higher farmland availability in China.

Comparison of provincial estimates shows a fairly close agreement between MEDEA-derived totals and the results of the 1985 land survey, with the greatest disparities for Hubei and Inner Mongolia (MEDEA's estimate being, respectively, 38 and 33 per cent higher) and for Zhejiang and Guangdong (MEDEA's estimates being, respectively, 24 and 39 per cent lower). The largest differences between MEDEA's provincial totals and official SSB claims were 278 per cent for Guizhou, 191 per cent for Sichuan and 183 per cent for Hubei (Figure 3).

MEDEA's farmland total prorates to a national mean of 0.122 ha (1,220 m^2) per capita in 1992, and 1,130 m^2 in 1997, and provincial rates calculated by using MEDEA estimates and official population figures show that (leaving the four large municipalities aside) the mid-1990s availability of farmland was less than 500 m^2 per capita in only three coastal provinces of South China – Guangdong, Fujian and Zhejiang (Figure 4).

Fields, Ponds, Orchards: New Patterns of Land Use and Nutrition

Although it is significantly higher than most of the new Chinese farmland estimates, I believe that even MEDEA's total may be too low. I believe it is logical to include aquacultural ponds and orchards in China's farmland total because these intensive land uses make very significant contributions to the country's balanced diet. Moreover, as shown in the next section, a large share of today's orchards and ponds (and in many counties and locales clearly a majority) has been converted from crop fields since 1980: land use has changed but the land has not only remained devoted to food production as it keeps supplying high-quality protein and desirable micronutrients, but its new uses also provide a variety of environmental benefits.

With an annual yield of 10 t of fish per hectare, a carp pond will yield

19. MEDEA, *China Agriculture, Cultivated Land Area, Grain Projections, and Implications* (Washington, D.C.: MEDEA, 1997).

Figure 3: **Provincial Differences Between Official Farmland Figures and MEDEA's Estimates**

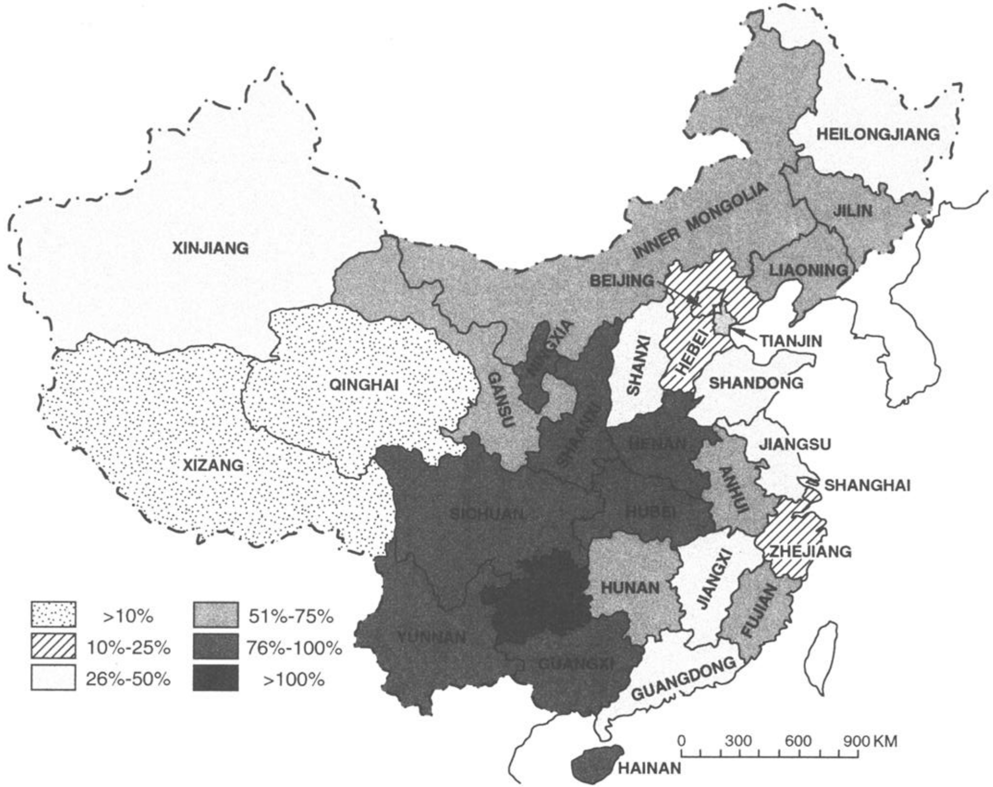


Figure 4: **Provincial Per Capita Availability of Farmland Based on MEDEA's Estimates**

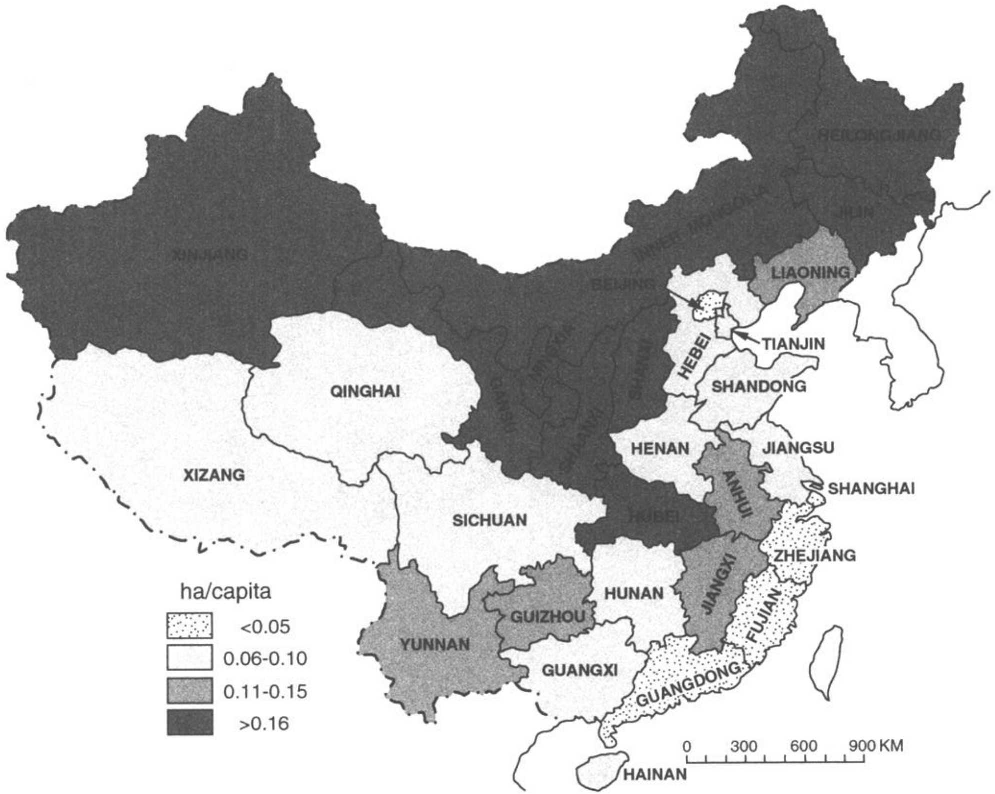


Table 2: **Comparisons of Food Energy and Protein Yields**

	Average yield (t/ha)	*Food energy (GJ/ha)*	*Protein (kg/ha)*
Rice	12.0	125	650
Carp	10.0	40	1,500

Sources:
Vaclav Smil, "Food production and quality of diet in China," *Population and Development Review*, Vol. 12, No. 1 (1985), pp. 25–45; FAO, *Food Balance Sheets* (Rome: FAO, 1996).

about 1,500 kg of protein, more than twice as much as good harvests of double-cropped rice from the same area (Table 2).[20] And unlike rice protein, which is always deficient in lysine, carp produce higher-quality protein with adequate amounts of all essential amino acids. And a hectare of well-tended oranges will supply annually 4–5 kg of vitamin C and 15 kg of potassium, two essential micronutrients produced in negligible amounts by a corn crop that would have been previously planted on the same slope land.[21]

Since the early 1980s China has been moving steadily away from the traditional diet dominated by grain staples. A generation ago cereals supplied about four-fifths of all food energy and two-thirds of all protein; by the mid-1990s cereals provided about 65 per cent of all food energy, and in large coastal cities their share fell close to 50 per cent.[22] In contrast, nation-wide per capita fruit supply, averaging no more than 6 kg/year during the late 1970s, rose to 35 kg/year by 1995, and fresh-water aquaculture now produces annually more than 8 kg of fish and crustaceans per capita compared to less than one kg in 1980.[23]

This new, more diversified, pattern of eating must be taken into account when assessing the resources available for food production. With the inclusion of ponds and other water surface now used for aquaculture (officially put at almost 5 Mha) and orchards (over 8 Mha, and increasing by more than 200,000 ha a year) China's land devoted to intensive food production would have been between 146 and 160 Mha in 1997. The mean of 153 Mha would mean that the country's 1997 average per capita availability of farmland was almost 1,250 m^2, or about 63 per cent above the rate calculated by using the official farmland estimate. The rate of

20. Yield of 10 t/ha is far from the top performance in China's intensive aquaculture; rice harvests of 6 t/ha are now fairly typical in major rice-growing provinces.

21. I have assumed fruit yield of no more than 10 t/ha, less than half of the average yield in the U.S. citrus groves.

22. For rice I have assumed an average milling rate of 70%, 15 MJ/kg of edible energy and 7.5% of protein; for carp I have assumed 15% food waste, 4.8 MJ/kg and 18% of protein.

23. China is now the world's largest producer of fresh-water fish and crustaceans. For details on output and species composition see FAO Fisheries Department, *The State of World Fisheries and Aquaculture 1996* (Rome: FAO, 1997).

$1,250 m^2$ compares to $490 m^2$ in South Korea, $430 m^2$ in Taiwan and $420 m^2$ in Japan.[24]

China's per capita farmland availability is thus 2.5–3.0 times as large as that of its East Asian neighbours. This is a convincing argument against Brown's conclusion that the country has a pressing shortage of farmland and hence has little choice but to follow soon the East Asian pattern of food supply, that is to shift towards a high degree of dependence on food imports, particularly on massive purchases of feed grain. But to what extent is this encouraging conclusion being undermined by China's substantial farmland losses?

Farmland Losses: A Closer Look

When taking a long-term perspective it is quite valid to argue that concerns about continuous losses of farmland throughout the densely settled eastern third of China are not lessened by the fact that the overall total of agricultural land is higher than the official claim. Cumulative magnitude and the recent rapidity of this decline have been clearly worrying – and given the existing trends of relatively low, but in absolute terms still substantial, population increase and rapid economic expansion it must be expected that high rates of farmland loss will continue for many years to come.

According to the official claims, mass deployment of rural labour reclaimed about 17 Mha of cropland between 1957 and 1977 – but the losses during those two decades amounted to 29 Mha, for a net decline of 12 Mha.[25] Since 1978 the spurt of rural and urban modernization led to even higher rates of land loss due to housing and plant construction. The greatest reported net loss of the 1980s, almost exactly one Mha, was in 1985; in 1986 it declined to about 600,000 ha, with the largest shares in Heilongjiang and Shandong.[26]

In the following year, when the total rose again to about 0.87 Mha, the State Land Administration Bureau introduced new regulations for the use of farmland for non-agricultural construction.[27] These permitted using 205,000 ha for all construction projects, including just over 60,000 ha for peasant housing. Post-1986 statistics detailing the causes of China's farmland loss show that between 1987 and 1995 rural construction (including new agricultural infrastructure, mainly land taken up by new water reservoirs and irrigation canals) removed annually only about 25,000 ha, but that urbanization and industrialization (including the

24. Farmland statistics for these three countries are among the most reliable in Asia, with errors unlikely to surpass 5%.

25. Central Committee of the Chinese Communist Party, *Zhongfa* No. 4, translated in *Issues & Studies*, Vol. 15 (1979), pp. 105–106.

26. Cao Zhaoqin and Wang Hangzeng, "China's arable land declines by 9 million *mu* in 1986," *Renmin ribao*, 18 May 1987, p. 1.

27. Yang Bangjie, "China makes public the plan for using farmland for non-agricultural construction," *Jingji ribao* (*Economic Daily*), 30 June 1987, p. 4.

Table 3: **Causes of China's Farmland Loss, 1987–95**

Causes of farmland loss	*Total*	*Annual mean* (10^3 *ha*)	*Shares* (%)
Urbanization and industrialization	788	88	14
Rural construction	157	17	3
Natural hazards	965	107	17
Conversion to forest and pastures	1,884	209	33
Conversion to orchards	1,240	138	22
Conversion to ponds	252	28	4
Agricultural infrastructure	71	8	1
Other	324	36	6
Total	5,681	631	100

attendant transportation infrastructure) claimed every year about five times as much farmland (Table 3).[28]

But, as shown in Table 3, even the combined total of urban and rural construction has been responsible for less than one-fifth of China's recent farmland loss. The single largest cause – a third of the total – has been the conversion to forests and pastures. In an overwhelming number of cases this was merely a return to uses predating Mao's irrational Cultural Revolution-era policies of "taking grain as the main link" which led to indiscriminate conversion of grazing and forested land to low-productivity grain fields.[29] These reversions should be welcome rather than regretted: reduced soil erosion, improved soil water retention, greater species diversity, more high-quality animal protein from grazing, and improved fuel and timber supply from new groves are obvious gains.[30]

The second largest share, slightly more than a fifth of the total loss, was the result of conversion to orchards. Again, in many instances this was just a reversion to long-standing uses of many slopes or low-productivity sandy soils: orchards chopped down during the madness of the Great Leap Forward and uprooted during the grain-planting campaigns of the late 1960s returned to their traditional sites. But the acceleration of field-to-orchard conversions during the 1990s has gone far beyond the restoration: it reflects the increased demand for fruit, both for steadily diversifying domestic consumption and for export.[31]

28. All figures in this table are from the State Land Administration Bureau, *Zhongguo tudi nianjian* (*China's Land Yearbook*) (Beijing: Zhongguo tudi chubanshe, 1997).

29. For details on pre-1979 conversions of slopelands, grasslands and wetlands into fields see Vaclav Smil, *The Bad Earth* (New York: M.E. Sharpe, 1984), pp. 15–68.

30. Reductions in soil erosion can be particularly impressive: annual topsoil losses from a sloping field planted with a row crop (most often corn) can be an order of magnitude higher than in an orchard with a grassy ground cover.

31. Six-fold expansion of domestic fruit supply during the past 20 years has been already noted. Chinese fruit exports (mainly oranges and apples) are now approaching 0.5 Mt a year, and are earning about US$200 million.

The third most important reason for farmland disappearance in China – land degradation caused by excessive erosion, desertification, salinization, alkalization – has been recently responsible for as much loss every year as combined urban and rural construction. Its causes are widespread: during the mid-1980s a nation-wide survey of nearly 45 Mha in 901 counties discovered various degrees of excessive soil erosion on 31 per cent of the land, desertification on 5 per cent, salinization and alkalization on 6 per cent, and waterlogging on 9 per cent.[32] The latest study of human-induced soil degradation in China concluded that water erosion affects 163 Mha of land, wind erosion 122 Mha, chemical deterioration 70 Mha and physical degradation about 30 Mha.[33]

Whatever their cause, two kinds of farmland losses have been most worrying: those occurring in areas with already inadequate food production capacity, and those eliminating the most productive grain fields and vegetable plots in suburban coastal areas. Guangxi, where millions of peasants still live in extreme poverty, and grain-deficient Gansu, a province losing thousands of hectares every year but gaining more than 330,000 people, are perhaps the best example in the first category. Widespread farmland loss in Jiangsu (the southern part of the province now has at least one new manufacturing enterprise every square kilometre) and in the Zhu River delta of Guangdong are the most obvious illustration of the second process.[34]

Cumulative effect of farmland losses has obviously weakened China's long-term food production capacity. Assuming the average mid-1990s cereal yield (4.5 t/ha) and mean multi-cropping ratio of 1.5, the net loss of about 20 Mha between 1950 and 1995 is an equivalent of forfeiting a food production base capable of supporting almost 250 million people on a largely vegetarian diet and about 175 million people on a diet similar to the one prevailing in today's China.[35] And the recent average annual loss of roughly 500,000 ha (not including conversions to orchards and ponds) means a loss of food production capacity for at least 4 million people consuming today's typical Chinese diet.

32. Chen Guonan, "Possible changes in China's farmland resources by the year 2000 and possible countermeasures," *Ziran ziyuan* (*Natural Resources*), No. 3 (1987), pp. 1–6, 26. By far the highest erosion rates are on the arid Loess Plateau: 274,000 km^2 of its total area of 580,000 km^2 have chronic erosion problems, with annual soil loss rates as high as 300 t/ha (or 2 cm/year): Tung-sheng Liu, *Loess in China* (Berlin: Springer-Verlag, 1988).

33. G.W.J. Van Lynden and L.R. Oldeman, *The Assessment of the Status of Human-induced Soil Degradation in South and Southeast Asia* (Wageningen: ISRIC/UNEP/FAO, 1997).

34. Farmland loss in rapidly industrializing coastal provinces is almost invariably accompanied by severe water pollution whose effects further weaken the average productivity of cultivated land as do higher levels of air pollution (particularly ozone) and uncontrolled solid waste disposal.

35. During the mid-1990s animal foodstuffs supplied, on average, about 15% of China's food energy, almost 30% of all protein and about 60% of all lipids: FAO, *Food Balance Sheets* (Rome: FAO, 1996), p. 89.

Long-term Outlook: Reasons for Concern

In 1997 China had at least 47 per cent (using MEDEA total) or just over 60 per cent (using MEDEA estimate enlarged by pond and orchard area) more farmland than indicated by its official statistics. As expected, this under-reported land is unevenly distributed among provinces: some of the greatest discrepancies are in hilly and mountainous areas where the quality of the unreported land will be relatively low and its degradation rates unacceptably high. But substantial under-reporting is the norm even in major regions of intensive multi-cropping, including Hubei (with MEDEA total 83 per cent above the official claim) and Jiangsu (with 45 per cent discrepancy), two provinces producing about 20 per cent of China's rice (Figure 3).

Naturally, these major underestimates of cultivated land mean general overestimates of officially claimed crop yields. But we should not assume any simple, direct relationship between overreported yields and under-reported land: the difference between official and real totals for sown area (now put by the SSB at about 155 Mha annually) may be substantially smaller than for the total cropland (more land could be simply fallowed or used for unreported planting of forages or green manures). And if the reported harvests are fairly close to actual grain production it cannot simply be assumed that China's real staple grain yields are up to 50 per cent lower than the official figures – but it must be appreciated that they must be substantially (at least 15 per cent for rice in some provinces and not uncommonly 40 per cent for corn in the south-west) lower than the reported rates.[36]

This means China's average grain yields are still appreciably below the South Korean and Japanese rates, giving the country more room to improve crop productivity by using additional inputs and better agronomic practices. Higher and less wasteful use of fertilizer, more efficient use of irrigation water and planting of better crop varieties are the essential ingredients of this strategy.[37] But this does not mean that China's continuing farmland losses should be viewed with equanimity: published figures, averaging about half a million ha since the early 1980s, may actually underestimate the real loss.

Not only Chinese agronomists but also the country's leaders are well aware of the unacceptably high rate of farmland loss. Central and provincial governments have issued a number of strict orders forbidding

36. In estimating total grain output the SSB statisticians rely on a common practice of sampling survey cuttings to calculate average yields – but then they inflate them by 20–30% in order to compensate for the under-reported land area: Frederick W. Crook and W. Hunter Colby, *The Future of China's Grain Market* (Washington, D.C.: U.S. Department of Agriculture, 1996).

37. China is the world's largest user of nitrogenous fertilizers but when this consumption is divided by at least 140 Mha of cultivated land the country's average annual applications prorate to about 140 kg N/ha, no more than the German or Japanese national mean. However, typical European and Japanese nitrogen fertilizer use efficiencies are at least 30% higher than the Chinese mean. For more on intensities of fertilizer use see FAO, *Fertilizer Yearbook* (Rome: FAO, 1997); for environmental consequences of these applications see Vaclav Smil, *Cycles of Life* (New York: Scientific American Library, 1997).

or greatly limiting cropland conversions to non-agricultural uses.[38] But it must be expected that even the most stringent orders against the conversion of farmland – those establishing permanent arable land reserves, areas where no farmland can be converted to any non-agricultural uses – will be repeatedly circumvented in such a precipitously modernizing economy ruled by pervasive corruption and by opportunities for some truly fabulous profits.

In contrast, a reform of land tenure would undoubtedly go a long way towards moderating or preventing farmland loss caused by soil degradation, and it would provide strong incentives for increasing the quality of currently low-yielding land. Good agronomic practices – appropriate tillage, suitable crop rotations, continuous recycling of crop residues and other organic wastes, and efficient use of fertilizer and irrigation water – can reverse deterioration in soil quality, but these cumulative improvements are predicated on assured long-term ownership of land.

Field surveys shows that peasants are willing to invest considerable amounts of capital to improve wasteland acquired on very long-term leases (50–100 years) in auctions, even in some of the country's poorest regions.[39] This indicates that a reform of the existing land tenure, that is replacement of relatively short-term leases by long-term property rights, would tend to improve the quality of land. Indeed, a revealing study in Hebei province showed that the use of manure falls by 0.1 m^3 and phosphate use declines by 0.34 kg for every year of tenure reduction. Given the mean difference of nine years between tenures of private and responsibility plots this means that farmers would have applied 18 per cent more manure and 36 per cent more phosphate fertilizer if they had managed responsibility plots in the same assiduous manner with which they tended their private land.[40]

But even a wider adoption of desirable agronomic practices would take time to translate into appreciably reduced farmland losses and better soil quality.[41] Consequently, China may not be able to prevent annual farmland losses on the order of 0.3–0.5 Mha a year during much of the next generation. This would add up to the loss of 7–11 Mha of farmland between 1998 and 2020, and even with yields stable at the mid-1990s' level this land could feed at least 60–90 million people. Gradually increasing grain imports are thus highly likely – but given China's export

38. For reports on recently approved rules aimed to limit the loss of farmland see "Nation tightens land-use approval," *China News Digest*, 20 January 1996 (http://www.cnd.org); "Government sets new rules to curb use of farmland," *China News Digest*, 18 May 1997.

39. Tim Hanstad and Li Ping, "Land reform in the People's Republic of China: auctioning rights to wasteland," *International & Comparative Law Journal*, Vol. 19, No. 3 (1997), pp. 545–580.

40. Scott Rozelle, Li Guo and Loren Brandt, *Land Tenure, Property Rights, and Productivity in China's Agricultural Sector* (Stanford, CA: Food Research Institute, Stanford University, 1996).

41. This is why the assumptions of a study conducted by the Chinese Academy of Sciences – which projects the share of land categorized in the first quality grade rising from 39.8% in 1990 to 50.7% by the year 2025 – may be too optimistic: CISNAR, *The Land Resources Production and Population-supporting Capacity in China* (Beijing: CAS, 1991).

earnings and the state of the world grain market there should be little problem with the country eventually doubling, or even tripling, its current low grain imports.[42]

Changing the balance between higher domestic production through farming intensification and higher reliance on food imports will be determined by complex interactions of economic growth, consumer demand, environmental degradation, world grain prices and policy preferences. But it would take an extraordinary concatenation of poor decisions and failures to adapt to shifting circumstances to justify any catastrophic scenarios of China's food production during the coming generation. The now indisputable fact that the country has at least 40 per cent, and perhaps as much as 60 per cent, more farmland than admitted by its official statistics is a major reason for a fairly hopeful outlook.

42. Four of the six published projections of China's grain imports by the year 2010 forecast levels no higher than 18–33 Mt/year (compared to recent rates of 10–20 Mt/year); only Lester Brown and the Overseas Economic Cooperation Fund put the annual total above 100 Mt/year: Weishuang Qu, "A comparison of seven China agriculture models," in: *The Strategy and Action Project for Chinese and Global Food Security* (Washington, D.C.: Millennium Institute, 1997).