Assessing Farmland Protection Policy in China

Erik Lichtenberg[1] and Chengri Ding[2]

[1] Erik Lichtenberg is a professor in the Department of Agricultural and Resource Economics at the University of Maryland, College Park, email: elichtenberg@arec.umd.edu. His research on this project was supported by a grant from the Lincoln Institute of Land Policy.
[2] Chengri Ding is an associate professor of Urban Studies and Planning and director of the Chinese Land Policy and Urban Management Program co-sponsored by the University of Maryland and Lincoln Institute of Land Policy, email: cding@umd.edu.

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Abstract

The government of China targeted conversion of farmland to industrial and residential uses, especially in the most productive agricultural regions, as the chief threat to the nation's continued capacity to produce adequate levels of staple cereals. In response, it has introduced a number of measures aimed at protecting farmland, especially farmland with the greatest production potential. This paper reviews the existing evidence regarding the performance of China's farmland protection policies in light of its food security goals. We summarize recent farmland protection measures. Despite administrative restrictions on farmland conversion, cropland continues to decline. The evidence suggests that a substantial share of farmland losses does not represent a reduction in food production capacity. It also suggests that increases in other factors of production can compensate for farmland losses and that farmland protection is not the most efficient—or even a necessary—means of meeting China's food security goals. However, the existing institutional and policy structure create incentives for both insufficient farmland retention and excessive farmland conversion, resulting in significant inefficiencies in land use. We discuss the implications of these failures for future policy development, with an emphasis on reform of the land allocation system.

Key words: China, farmland conversion, farmland preservation, food security, land allocation

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Introduction

The government of China has had pronounced concerns about its ability to continue feeding a growing population since the mid-1990s, when Lester Brown (1995) predicted that China would soon need to resort to grain imports on a scale massive enough to cause severe disruptions in world markets. Like Lester Brown, the government of China targeted conversion of farmland to industrial and residential uses, especially in the most productive agricultural regions, as the chief threat to the nation's continued capacity to produce adequate levels of staple cereals. According to official government statistics, China lost over 14.5 million hectares of arable land between 1979 and 1995. While those losses were partially counterbalanced by the addition of 10.1 million hectares of arable land from reclamation activity, that additional arable land was lower in quality and located in areas with less favorable climatic conditions, suggesting that the loss of agricultural production capacity exceeded the net loss of arable land (Ash and Edmonds 1998). Farmland land losses on such a scale could well be significant for China: Even though it has a territory roughly equal in area to that of the United States, only about a third of that land area can be utilized productively for agriculture.

The government of China responded to these food security concerns by introducing a number of measures aimed at protecting farmland, especially farmland with the greatest production potential. Nevertheless, land planted to the staple cereal crops wheat and rice has continued to fall, as has the amount of "cultivated" land. For example, yields and sown area of wheat and rice, the principal staple food grains, peaked in 1997 and has fallen steadily since (Economic Research Service).

This paper draws on information from the published literature, from recent studies of farmland preservation commissioned by China's Ministry and Land and Resources, and from recent land use statistics published by China's Ministry and Land and Resources to assess the performance of China's farmland protection policies in light of its food security goals. We begin with a description of those policies. We then examine the extent to which those policies address actual losses in food production capacity. Next, we consider whether farmland protection is the most efficient—or even a necessary—means of meeting China's food security goals. Finally, we discuss inefficiencies in farmland conversion, examine previously unrecognized causes of excessive land conversion and unintended consequences of China's farmland protection policies, and discuss implications for future policy development.

Farmland Protection Policy

Two principal laws govern farmland preservation efforts in China: the Basic Farmland Protection Regulation, passed in 1994, and the New Land Administration Law, enacted in 1999.

The Basic Farmland Protection Regulation

The Basic Farmland Protection Regulation applies to five classes of land: (1) "cultivated land" currently planted to food grains, cotton, and oilseeds; (2) "cultivated land" with good irrigation, drainage, and erosion control, along with medium and low quality land on which irrigation, drainage, and erosion control measures are being installed; (3) land planted to vegetables; (4) experimental plots for agricultural research and development; and (5) other cultivated land as determined by the State Council. It is important to recognize that the term "cultivated land" does not correspond exactly to

what would be defined as farmland in most countries. Instead, it refers only to land used to grow major food grains, feed grains, soybeans, and tubers. Not included is land used in other kinds of food production; in particular, the Basic Farmland Protection Regulation does not apply to tree fruits, viticulture, or fish ponds.

The law requires governments at or above the county level to designate a basic farmland protection zone in every village or township. Determination of basic farmland and designation of these farmland protection districts is subject to approval by higher government bodies up to the level of the State Council. There are two kinds of basic farmland protection districts. The first level consists of high-quality land with high productivity; the law prohibits converting such land to nonagricultural uses. The second level consists of good-quality land with moderate productivity; the law permits conversion of such land to nonagricultural uses under some circumstances, usually after a planned period of 5 to 10 years. The regulation further stipulates: 1) if the conversion of land within farmland districts is unavoidable in order to build national projects, such as highways, energy production or transportation, the state must approve the conversion of land parcels of more than 500 mu while the provincial governments must approve those of less than 500 mu; and 2) the same amount of farmland lost to conversion must be replaced by new farmland somewhere else. The act thus imposes a so-called “dynamic balance” (what in the US would be termed a “no net loss”) policy whose intent is to keep the total amount of basic farmland constant in the face of pressures from urbanization and infrastructure construction.

The New Land Administration Law

The 1999 New Land Administration Law is intended to protect environmentally sensitive and agricultural lands, promote market development, encourage citizen involvement in the legislative process, and coordinate the planning and development of urban land. Article 33 stresses the focus on the dynamic balance (no net loss) of farmland policy in the Basic Farmland Protection Regulation to all farmland. It states:

> People's governments of provinces, autonomous regions and municipalities directly under the Central Government should strictly implement the overall plans and annual plans for land utilization and take measures to ensure that the total amount of cultivated land within their administrative areas remains unreduced. Where the total amount of cultivated land is reduced, the State Council shall order the government concerned to reclaim land of the same quality and amount as is reduced within a time limit…. Where individual governments of provinces or municipalities directly under the Central Government, for lack of land reserves, can not reclaim enough land to make up for the cultivated land they used for additional construction projects, they shall apply to the State Council for approval of their reclaiming less or not land within their own administrative areas but of their reclaiming land in other areas.

The law reinforces farmland preservation efforts by requiring an approval from the State Council for any conversion of basic farmland; conversion of farmland larger than 35 hectares; and conversion of other land larger than 70 hectares. It further encourages land development in areas that are considered wasteland or that feature low soil productivity. Despite the stipulation that the dynamic balance (no net loss) of farmland policy be

implemented at provincial levels, in practice this provision is actually carried out at the city, county, and sometimes township levels. Article 34 requires that basic farmland not be less than 80 percent of total cultivated land in provinces, autonomous regions and municipalities directly under the central government.

Articles 17 through 26 establish the mechanisms and principles of planning and implementing overall plans for land utilization. A comprehensive scheme of urban development has been widely developed across Chinese cities in order to provide appropriate means to achieve balanced development between society, economy and environment (Tang and Liu 2002). This scheme requires that urban development be coordinated through planning to eliminate redundancy and duplicated construction, rationalized in layouts so that land use is efficient, and provided with sufficient infrastructure. It is thus expected that urban development patterns will be different from those of the pre-reform period.

How Much Farmland Has Actually Been Lost?

The motivation for China's farmland preservation legislation is the desire to ensure that the nation remains capable of feeding its growing population despite its limited land base. Two major questions arise in this context. First, what is the scale of farmland loss? Second, how much of that farmland loss represents a loss of agricultural production capacity?

While it is clear that China has been experiencing losses of farmland, a lack of consistent, reliable data makes it difficult to identify trends in farmland loss with much precision. Official figures published by the State Statistical Bureau are known to have underreported farmland by a substantial margin, at least up until the mid-1990s. The

State Statistical Bureau reported 96.8 million hectares of cropland in 1985 and 94.9 million hectares in 1995. Cropland estimates derived from remote sensing and detailed surveys exceed the figures reported by the Bureau during this period by more than 40%. Reconstructed estimates of total cropland vary substantially, raising problems of comparability. Estimates of total cropland in China for the early to mid-1990s range from 125 to 145 million hectares (US Embassy 1997, Heilig 1997, Ash and Edmonds 1998, Smil 1999). The comprehensive land survey conducted in 1996 by the Ministry of Land and Resources reported 130.0 million hectares of cultivated land and 10.0 million hectares of horticultural land (Lin and Ho 2003). By 2003, cultivated land had fallen to 123.4 million hectares,; however, horticultural land had risen to 11.1 million hectares while land in other agricultural uses (notably livestock breeding and production facilities) amounted to 25.5 million hectares, giving a total of 134.5 million hectares of cropland and 160.0 million hectares in agriculture (Ministry of Land and Resources 2004).

The poor quality of historical statistics makes it difficult to determine exactly how much farmland was lost prior to 1996. Estimates of gross cropland losses between 1987 and 1995 run on the order of 5.7 to 8.4 million hectares (Ash and Edmonds 1998, Smil 1999). Additions of cropland due to reclamation bring net losses during this period down to 1.7 to 4.7 million hectares (Heilig 1997, Heilig 1999, Yang and Li 2000). The rate of cropland loss seems to have accelerated since 1995: Net losses of cropland between 1996 and 2003 amounted to 5.4 million hectares (Lin and Ho 2003, Ministry of Land and Resources 2004).

Losses of cultivated area have been concentrated in the most productive farming areas of the country while reclamation activity was greatest in the less productive western

and border provinces. The coastal and central provinces have more fertile soils than the remainder of the country as well as climates that allow multiple cropping. Farmland in the coastal provinces can be cropped 2-3 times a year, while land in the central areas can be cropped 1-2 times per year. By contrast, land in the western and border provinces can be cropped at most once annually (Ash and Edmonds 1998). Provinces in coastal and central China lost an estimated 1.5 to 2.1 million hectares of cropland (i.e., cultivated land plus horticultural land) between the mid-1980s and mid-1990s and an additional 3.5 million hectares between 1996 and 2003 (Heilig 1997, Heilig 1999, Ash and Edmonds 1998, Yang and Li 2000, Lin and Ho 2003, Ministry of Land and Resources 2004).

Farmland Loss and Agricultural Production

Not all of what have been labeled farmland losses in the literature represent land removed from food production. As noted above, contrary to standard practice in the US and elsewhere, the reporting category "cultivated land" includes areas used for major food grains, feed grains, soybeans, and tubers. It does not include horticultural crops, nor does it include aquaculture. A substantial share of the farmland reported lost was, in fact, converted to horticulture or aquaculture. Smil (1999) has estimated that about a quarter of the observed reduction in "cultivated" land occurring in China between 1987 and 1995 was due to conversion to orchards and fish ponds. Lin and Ho (2003) estimate that horticulture and fish ponds accounted for half of the decrease in "cultivated" land reported in 1994. China's Ministry of Land and Resources (2003) reported that gardens, orchards, and fish ponds together accounted for about a fifth of the "cultivated" land lost between 2001 and 2002. Increases in horticultural land offset about one-sixth of the loss

of “cultivated” land between 1996 and 2003 (Lin and Ho 2003, Ministry of Land and Resources 2004).

It is also important to note that some cropland losses represent only minor, if any, reductions in agricultural production capacity. Much of the land newly brought under cultivation prior to 1987 was marginal in terms of agricultural productivity but highly vulnerable to erosion, desertification, and other forms of land degradation. After 1987, much of that land was allowed to revert to more sustainable uses like pasture, grassland, and forest. Reversion of land to these more sustainable uses accounted for over a third of the loss of “cultivated” land up to the mid-1990s, almost two-thirds of the loss of “cultivated” land between 2001 and 2002, and over seven-eights of the loss of “cultivated” land between 2002 and 2003 (Ash and Edmonds 1998, Smil 1999, Yang and Li 2000, Lin and Ho 2003, Ministry of Land and Resources 2003, Ministry of Land and Resources 2004). Because the productivity of this land was quite low, its removal from cultivation represents little, if any, reduction in agricultural production capacity.

Reallocation of farmland from cereals and tubers to fruits, vegetables, and fish is more appropriately characterized as a natural accommodation to changing consumer demand rather than a sign of an inability to maintain staple food production. Food consumption patterns have been changing as China’s population has become more urbanized and as its income has grown. In particular, consumption of staple cereals has been falling while consumption of vegetables, fruits, fish, poultry, and meat has been rising. In 2002, for example, average grain consumption by urban Chinese households was only one-third that of rural households. Vegetable and oil consumption was roughly equal for urban and rural households, but urban households consumed 2-3 times as much

red meat, poultry, eggs, and aquatic products as rural households (Economic Research Service). High income urban residents consumed less rice and wheat but substantially more vegetables, red meat, poultry, eggs, milk, and aquatic products as low income urban residents (Hsu, Chern, and Gale 2002). These dietary shifts have been occurring since the early 1980s (Smil 1999) and have continued into the present. As an indication, consumption of grains in China fell slightly between 1995 and 2002, even though total population increased by about one-eighth during that period; rural-to-urban migration changed diets sufficiently to effect a net reduction in grain consumption (Economic Research Service).

Cropland allocations have changed in accordance with these changes in diet and thus consumer food demand patterns. Total sown crop area increased by over 5 million hectares between 1995 and 2002 (this figure includes multiple cropping). Area planted to food grains declined slightly, but area planted to vegetables, fruits, soybeans, and feed grains increased substantially. As a result, between 1995 and 2001, production of vegetables almost doubled while production of fruits (other than melons) increased by about three-fifths (Economic Research Service).

Impacts of Farmland Conversion on Food Security

Farmland conversion raises concerns about food security because land is such an important factor of production in agriculture. Those concerns are especially grave because of the scarcity of land in China and because China's rate of farmland conversion is relatively high. China has about 0.10 hectares of cropland per capita compared to 0.47 hectares of cropland per capita in the United States and 0.69 hectares per capita in the European Union. Between 1996 and 2003, China lost cropland at an average annual rate

of cropland loss of 0.6 percent. By comparison, between 1961 and 2002 the respective average annual rates of cropland loss in the European Union and United States were 0.4 and 0.1 percent.

Land is not the only factor of production that matters in agriculture, however, and other factors production can and do compensate for reductions in cropland. In the United States and Europe, for example, increases in capital, agricultural chemicals, energy, seed, and other intermediate inputs have more than compensated for reductions in land and labor in agriculture (Ball et al. 1997, Ball et al. 2001). For that reason, most observers believe that China can remain largely self-sufficient in food production with current rates of population growth and farmland loss despite its scarcity of additional arable land (Huang, Rozelle, and Rosegrant 1999, Interagency Agricultural Projections Committee 2004, Alexandratos 1995, Heilig 1999, Smil 1999). The technical keys to success in meeting China's food security goals appear to lie in most notably irrigation, flood control, and R&D, along with modest increases in imports of selected, mostly non-strategic commodities (Huang, Rozelle, and Rosegrant 1999).

Many farming regions face shortages of water for irrigation (Heilig 1999, Lohmar et al. 2003). Farmers in many regions that rely on groundwater have pumping at unsustainably high rates; water tables are falling rapidly as a consequence. Water shortages are affecting even regions with abundant water resources because poor maintenance and operation of irrigation systems results in substantial losses of surface water diverted for irrigation. Improved flood control is also sorely needed; as noted above, natural disasters—largely floods—have been one of the largest sources of crop and cropland losses.

China has a highly productive agricultural research and development system, which has yielded high rates of return in recent years (Fan 2000). That system has been quite successful in developing and promulgating new crop varieties that have increased potential grain yields at average annual rates of 1.5 to 2.5 percent annually, while outreach efforts by China's extension system during this period resulted in dissemination of varieties and cultivation methods sufficient to cut the gap between potential and actual yields in half (Jin et al. 2002). Total factor productivity has grown at consistently high rates over the past two decades, especially during periods of high investment in agricultural research and development (see for example Rozelle et al. 1997, Jin et al. 2002, Fan and Zhang 2002, Carter et al. 2003). The use of biotechnology promises to increase agricultural productivity substantially in the near future (see for example Fellini et al. 2003, Huang et al. 2004).

As noted above, one dietary consequence of urbanization and income growth is increased consumption of meat and poultry, which obviously require production of feed. Land allocated to feed production has, in fact, increased. Additionally, imports of feed (e.g., soybeans from Brazil) have been playing an increasingly important role in Chinese livestock production (Naylor et al. 2005). Such a phenomenon is exactly what the standard economic theory of international trade would lead one to expect: China is able to compensate for its scarcity of land by importing land-intensive commodities. In 2003, for example, China imported about five-ninths of the soybeans it used (Tuan, Fang, and Cao 2004). At the same time, increased reliance on imports for livestock feed is unlikely to pose a severe threat to China's food security.

Farmland Loss and Urbanization

While the loss of cultivated land does not appear to be the critical nexus of China's food security problems, the evidence does suggest quite strongly that there are substantial inefficiencies in land allocation generally and farmland conversion in rapidly urbanizing areas in particular. These inefficiencies have significant social costs, including—but not limited to—adverse effects on the maintenance of China's food production capacity.

From the perspective of food security, the most worrisome aspect is that losses of cultivated area to urban uses have been concentrated in the most productive farming areas of the country: The coastal and central provinces, which have more fertile soils than the remainder of the country as well as climates that allow multiple cropping. Net losses of cropland in these provinces appear to have been on the order of 2 million hectares between 1985 and 1995. That rate of loss accelerated to 3.5 million hectares between 1996 and 2003. Urbanization, industrialization, infrastructure, and other non-agricultural uses appear to have been an especially large source of farmland loss in these rapidly industrializing coastal provinces. For example, in 1995 over two-thirds of the cultivated land loss in Beijing, Tianjin, Shanghai, Hebei, Shandong, Jiangsu, Zhejiang, and Fujian provinces were due to conversion to non-agricultural uses (Ho and Lin 2004).

Two sites selected as special farmland protection study areas by the Ministry of Land and Resources illustrate the scope of this problem. One site was Pinghu City, located halfway between Hangzhou and Shanghai in Zhejiang Province. Most of the land in Pinghu is prime agricultural land that can be cropped two or three times a year. Cultivated land and orchards account for about two-thirds of the total land area. Very

little land is left unused. Land taken for construction increased eightfold between 1998 and 2001. The local government has used consolidation of plots to meet its dynamic balance (no net loss) requirements but the scope for further gains from consolidation is quite limited. Recorded conversion of farmland to urban uses during this period of rapid growth amounted to almost 2 percent of Pinghu City's 1998 farmland (Wu, Ye, and Fang 2004).

The other site, Jingzhou City, located in the Yangtze River basin west of Wuhan in Hubei Province, shows how limited the impact of urbanization has been outside of these rapidly growing coastal provinces. Cultivated land and orchards together account for about about half of the total land area. Between 1997 and 2003, cultivated land in Jingzhou also decreased by almost 2 percent. But only a tenth of that loss was due to transportation infrastructure and other urban uses. Over half of the decrease in cultivated land was due to an increase in water area, some of which was due to flooding while the rest represents aquaculture facilities. The remainder was largely due to abandonment of marginal land brought under cultivation prior to 1978, which was either allowed to revert to forest or was simply left unused (Shi 2004).

The Role of Institutional and Policy Failures

Arguably the greatest impediments to China's ability to maintain adequate levels of food production are not physical but institutional. Institutional failings affect both supply and demand for farmland conversion, that is, both the willingness of farmers to retain their land and well as incentives for converting farmland to urban uses. In other words, distortions and/or inefficient uses of existing farmland arise from institutional

problems in the set of policies affecting returns to farming and those affecting gains from land conversion.

Policies Inhibiting Farmland Retention

On the supply side, a lack of tenure security, the collapse of irrigation management institutions, and the lack of adequate marketing infrastructure combine to undermine the economic incentives for farmers to remain in farming, especially in rapidly urbanizing areas (Carter and Rozelle 2001).

Tenure Security

Economists have argued on general principles that secure tenure is essential for efficient land use, including appropriate levels of investment in maintaining and enhancing land productivity as well as allocating land to the most efficient uses and/or users. Rural and suburban land belongs to village collectives and is administered by the village committee or economic organization, subject to oversight by township, provincial, and, in some cases, state organs. Rural collectives have the authority to allocate land to alternative uses such as farming, construction, housing, public works, and village enterprises (Ho 2001, Ho and Lin 2003). Farmland is leased to households under contractual arrangements in which the household pays a fee (typically including a grain quota) to the collective in return for a residual claim on the products of the land. The contract may contain other stipulations as well (for example, requirements that the land be farmed and maintained in good condition). The size of each household's allocation is based on the size and composition of the household and may be altered as the size and composition of the household change.

In many villages, reallocations have occurred frequently enough to deter investment in land productivity. For example, an econometric study by Jacoby, Li, and Rozelle (2002) using data from villages in Hebei and Liaoning Provinces in 1995 found that farmers facing a greater risk (frequency) of land reallocation invested less in organic fertilizer (which improves soil structure and hence long term productivity). An econometric study conducted by Deininger and Jin (2003) using more recent (2001) data from villages in Guizhou, Hunan, and Yunnan Provinces found that farmers in villages with a policy of no land readjustments for population changes were more likely to invest, and invested more, in agricultural improvements. Farmers with land-transfer rights were similarly more likely to invest in agricultural improvements.

Concerns over adverse effects on long term investment in maintaining and improving land productivity due to insecure tenure have led the Chinese government to experiment with lengthening the duration of farmland contracts. In 1984, collectives were urged by the state to contract with member households for a period of 15 years. In 1993, the state urged an extension of standard contract length to 30 years. In 1998, revisions to the Land Management Law explicitly required that all farmland contracts be (a) written and (b) effective for a term of 30 years with few or no adjustments allowed. Experiments with contract durations of 50 and 60 years have also been conducted in recent years (Deininger and Jin 2003, Ho and Lin 2003).

Farmers have also acquired some ability to alter land allocations may also be altered by exchanges or subcontracting. Exchanges among village households in order to consolidate holdings have been in evidence since the introduction of the Household Responsibility System in the early 1980s, as has been subcontracting of land to non-

members, especially by village members migrating in search of work. Exchanges of land among villagers were declared legal in 1986. Subcontracting of land to outsiders, subject to approval of two-thirds of the village membership, was declared legal in 1998 (Liu, Carter, and Yao 1998, Ho and Lin 2003).

Implementing these enhanced tenure security and transferability measures fully remains difficult, however, because they run contrary to longstanding practices and principles of administration in China. For one thing, they force the state to rely more on market mechanisms to ensure adequate grain supplies. For another, they limit the power of the collective—and, in particular, the village leadership. Enhanced tenure security may also result in less equitable land allocations, since periodic reallocations of land to accommodate changes in household size and composition or compensate for unanticipated adverse events ensure greater equity in access to food (Liu, Carter, and Liao 1998). In fact, widespread non-compliance on the part of local authorities led the central government to enact new legislation in 2002 explicitly forbidding changes in land usage rights prior to expiration of contracts and reaffirming farmers' rights to transfer, sub-lease, exchange, or voluntarily merge land use rights.

Ensuring that these reforms take hold fully is likely to increasingly important for maintaining agricultural productivity, especially in areas experiencing rapid urban growth. In those areas, farmland retention is likely to be a greater problem in the future than farmland preservation, i.e., preventing abandonment of productive farmland is likely to be a greater problem than preventing conversion of farmland to urban uses. Urban employment opportunities are widely available in fast-growing coastal areas. A large and growing proportion of the men of prime working age in these areas are employed in the

urban sector, leaving a farm labor force composed primarily of women and the elderly. Farmers interviewed stated that as many as 80 percent of the young men in the environs in Pinghu City worked in industry in nearby cities; in Jiangzhou, which has a lower level of industrial development, the comparable figure was 20 percent. Lack of urban residency rights keeps these families tied to the land but since their main source of income is non-agricultural, they have little incentive to invest in maintaining and enhancing land productivity. Moreover, limitations on labor time and capacity may induce them to leave some land uncultivated.

Such flows of labor out of farming can be accommodated by consolidating plots into operational units of sufficient size for exploiting economies of scale through expanded use of machinery and other means—as the history of agriculture in developed countries has clearly shown. But secure, transferable use rights are essential for allowing subcontracting land in order to accomplish increases in operational scale through consolidation and in order to give lessees sufficient incentives for investing in land productivity. In areas like Pinghu, for example, wages in urban employment are so much higher than returns to farming that farmers have little incentive to invest in the maintenance and enhancement of land productivity by applying organic fertilizer or keeping irrigation and drainage systems in good repair. Consolidation of small plots into sufficiently large operating units could both lower land productivity investment costs and increase returns to farming sufficiently to make increased investment in land worthwhile for farm operators.

Secure tenure rights act as a check on the arbitrary exercise of authority by village leaders who have been known to expropriate land from farmers to lease to rural

enterprises or to sell to local governments, often without paying compensation and in many cases pocketing the returns themselves (Cai 2003, Ho and Lin 2003). Illegal land development of this kind has become a national scandal. Millions of farmers are known to have lost land due to illegal land development. According to the Ministry of Land and Resources, farmers were owed at least $1.2 billion in compensation and relocation fees (Xinhua News Agency 2004).

Irrigation and Drainage Management

The water shortages China has been experiencing in recent years are due primarily to institutional failings, most notably (1) lack of clearly delineated and enforced use-rights for water, (2) inadequate financing of water delivery infrastructure, and (3) failure to price water at its opportunity cost.

The lack of clear use-right assignments results in upstream users taking too large a share of the water available, leaving inadequate supplies for downstream users—a phenomenon that applies equally at the provincial level, where upstream provinces divert excessive quantities of streamflow, and the farm level, where farmers with land at the heads of delivery canals take excessive amounts, leaving little or nothing for those at the tails of those canals (Lohmar et al. 2003).

Funding for construction, maintenance, and operation of irrigation systems has been inadequate because these activities have no dedicated funding source, so that maintenance varies with the overall status of government finances. According to local officials in Pinghu and Jingzhou, for instance, maintenance of irrigation and drainage systems virtually ceased after the introduction of the Household Responsibility System around 1980. In recent years, local government bodies have been attempting to remedy

these years of neglect by investing in repair and upgrades of irrigation systems. Lack of funds, however, restricts these efforts to a less than adequate pace. In Jingzhou, for instance, officials estimate that at current funding levels it will take 50 years to repair all irrigation systems currently in need. Many systems that have been repaired recently are likely to need further maintenance before systems currently in need of repair have been attended to.

Additional inefficiencies in water use arise in China because water prices are not set to reflect opportunity costs. Many farmers are charged for water according to the amount of land farmed rather than the amount of water used. Charges may be set to raise revenue for the township or provincial treasury rather than to induce economically efficient water use. As a result, farmers have insufficient incentive to adopt water conservation measures. Experiments with water users associations set water charges to defray local operational expenses plus the costs of delivering water to the village have found farmers' use of water conservation methods to be quite price-responsive. As in other parts of the world, then, water price reform has a significant potential to alleviate water shortages by promoting conservation (Lohmar et al. 2003, Lin 2002).

Reform of irrigation institutions has important implications for maintaining China's food production capacity generally and for preserving farmland specifically. As noted above, key sectors of China's agriculture are critically dependent on irrigation; failure to alleviate growing water shortages could seriously undermine China's food self-sufficiency goals. Alleviation of water shortages, increased delivery reliability, and improvements in water quality due to reductions in pollution should help increase

agricultural productivity and thus profitability, thereby reducing incentives to convert farmland to non-farm uses and thus slowing the rate of farmland conversion.

Marketing Infrastructure and Institutions

Inadequate marketing infrastructure and institutions remain a great impediment to realizing potential gains from regional specialization in food production as well as a deterrent to investment in agriculture in many localities. China has a long tradition of promoting self-sufficiency at the local and provincial levels. This tradition remains strong. For example, the initial response of the government to Lester Brown's predictions of massive food shortages was the enactment of the Governors' Grain Bag Policy requiring each province to maintain self-sufficiency in grain. Reliance on self-sufficiency can, however, become an impediment to economic growth by limiting the scope for gains from specialization. China has been moving away from this traditional stance. Grain trading, for example, has been partially liberalized and grain traders are creating more integrated national markets (Rozelle et al. 2000, Gale 2002). Greater market liberalization could contribute to farmland preservation and the maintenance of food production capacity more generally. More closely integrated national markets should increase average prices and decrease price volatility, making farming more attractive relative to other forms of employment. Greater market integration should be especially beneficial in poorer inland areas where incentives to migrate toward fast growing coastal cities have been especially strong.

Greater market liberalization will require significant investment in infrastructure, however. China's transportation network has not expanded fast enough to keep pace with the growth of trade volume. China lacks sufficient warehouse and cold storage facilities.

Reductions in post-harvest losses can be an important means of augmenting food supplies, especially in developing countries. Gilmour and Gale (2002) estimate that China has sufficient cold storage capacity to accommodate only 20 to 30 percent of demand, resulting in spoilage losses of perishable freight on the order of one-third. Increases in cold storage capacity could therefore increase food availability substantially by reducing spoilage losses. Increased cold storage capacity can also reduce price volatility, giving farmers an incentive to increase supply. For example, in farmers in areas surrounding Pinghu City are deterred from increasing production of vegetables because of high price volatility. Increases in cold storage facilities would reduce price volatility by smoothing supply; production of horticultural products would likely increase as a result. Expanded provision of electricity could further increase the effective food supply by allowing consumers to reduce spoilage losses by refrigerating produce.

Policies Encouraging Farmland Conversion

On the demand side, several features of the current policy environment combine to encourage excessive farmland conversion (and inefficient land use more generally)—even in areas where the central government has made farmland preservation a top priority. Policies influencing government finance, residential construction, and urban land transactions combine to create a high demand for land. Policies governing payment for land make farmland conversion the most attractive means of meeting that demand. In other words, the current policy environment generates incentives for local governments to convert farmland to urban uses strong enough to more than counterbalance the central government's attempts to limit farmland conversion.

Arbitrage Opportunities in Farmland Conversion

Urban land is allocated by a combination of administrative, quasi-market, and market mechanisms that create substantial arbitrage opportunities for private enterprises and for government entities. State and non-profit entities receive a land allocation valid without specific time limits. Municipal governments may also lease land to private enterprises for terms that vary according enterprise type. The standard term is 40 years for commercial enterprises, 50 years for industrial enterprises, and 70 years for residential uses.

The lessee pays a conveyance fee for the right to use the land for that term plus land use taxes at rates set by the state according to city size. The conveyance fee is usually negotiated between the lessee and the local government rather than being determined in an auction or public tender that would bring market forces to bear (Lin and Ho 2005). Lessees are allowed to sublease land and can therefore profit from arbitrage opportunities created by any divergence between the value of land in the secondary market and conveyance fees negotiated with the local government (Ho and Lin 2004, Ding 2003).

While such secondary markets create incentives for more efficient use of existing urban land, they also create incentives for excessive conversion of rural land, which can be purchased by local governments for re-conveyance in return for yet another administratively set compensation package that is typically considerably less than the conveyance fee. Conveyance fees, which used to be divided between various levels of government, now go entirely to local governments. Revenue from land transactions is a major source of funding for local governments as well; according to some estimates, it can account for anywhere between a quarter and half of all municipal revenue. As a

result, local governments have strong incentives to expand into rural areas in order to finance their ongoing obligations in the areas of infrastructure and housing (Ho and Lin 2004, Ding 2003).

Low administratively set compensation levels for rural land also create incentives for illegal land transactions that allow rural collectives, rather than urban governments, to profit from conversion, thereby undermining the state's control over land use (Ho and Lin 2003). They also create incentives for other types of illegal land transactions as well, notably forcible takeovers by local officials of land whose owners are unwilling to sell (Cody 2004).

Housing Regulations

Current regulations also make it more attractive for local governments to provide housing for growing populations by expanding into rural areas rather than increasing density within existing urban boundaries. Redevelopment of existing municipal land requires governments to pay compensation to current tenants and to cover resettlement expenses. Compensation paid to current residents is much higher than that paid to rural inhabitants. In Beijing, for example, land costs (primarily compensation) makes up as much as 60 percent of the cost redevelopment of existing urban areas compared to 30 to 40 percent of the cost of developing converted rural land. Tenants may also resist displacement tenaciously, which at the very least creates significant delays. In addition, it is more expensive to provide infrastructure to denser residential development. These factors combine to make it cheaper and easier to meet housing needs by converting rural land rather than increasing density within the existing municipal boundaries (Ding 2003).

Promotion of Economic Growth

Industrial development is widely seen as the key to economic growth and a rising standard of living for municipalities as well as for advancement of local government officials. Low land costs have encouraged local governments to acquire and set aside land for industrial development speculatively, that is, in the hope of attracting industrial investment. Much of that land has remained idled as hoped-for investment failed to materialize. By 1996, there were roughly 116,000 hectares of idle undeveloped land in economic development zones, over half of which was converted farmland that could no longer be converted back (Cai 2003, Ho and Lin 2004).

Impacts of China's Farmland Preservation Policies

Paradoxically, China's farmland protection policies may also contribute to insufficient farmland retention and excessive farmland conversion. They contribute to excessive farmland conversion by promoting urban sprawl. They contribute to insufficient farmland retention by inhibiting rationalization of land holdings and agricultural production units. They prevent the development of contiguous urban areas, which increases transportation costs and imposes high social costs due to clustering of incompatible land uses. More importantly, they push economic activities into locations that may not provide any locational advantage and adversely affect urban agglomeration, which ultimately affects the competitiveness of the local economy.

The designation of basic farmland is based primarily on historic land use and soil productivity. Farming has traditionally been more intensive—and hence more productive—in areas with high population densities, so that farmland close to major cities is more likely to be designated than farmland farther away. Prohibiting conversion of

basic farmland thus results in leapfrogging development and urban sprawl. It also creates mixed land use patterns in which villages are absorbed within cities and cities are imposed on villages. These patterns are common in regions with high population density and fast growth rates, such as the Pearl Delta of Guangdong Province. The mixed village and city pattern aggravates an already underfunctioning urban agglomeration that results from a relatively high level of immobility in the population because of the *hukou* system, which gives residents access to certain heavily subsidized local amenities such as schools.

Prohibiting conversion of land designated as basic farmland also constrains site selection for economic development projects. These constraints increase the price of land and thus raise the cost of doing business. They also create an *ad hoc* land development process, which results in a chaotic and uncoordinated land development pattern, less efficient utilization of existing infrastructure use, and higher costs for local government provision of urban services. These problems are exacerbated by the differential treatment of basic and non-basic farmland. Farmers whose land is designated basic farmland are penalized by a denial of access to urban land markets, even if their farms may enjoy a location advantage. Farmers from areas not designated as basic farmland are not similarly constrained. This inequitable treatment makes it difficult for local governments to implement effective land management tools and creates social tensions that make the land acquisition process more difficult, lead to chaotic and uncoordinated development, and encourage the development of hidden or informal land markets.

Implications for Policy Development

The preceding discussion suggests that while farmland preservation is not needed to meet China's food security goals, policy changes are needed to ensure that farmland conversion results in rational land allocations. China's current farmland preservation programs are not designed to meet this latter goal, however. Those policies do not appear to have been adequate to slow the rate of farmland conversion in areas subject to high development pressure but do appear to have inhibited efforts to rationalize land use.

One problem is that China's farmland preservation laws take a one-size-fits-all approach, requiring the same level of farmland protection in all regions and at all administrative levels. Such an approach is hard to maintain in a country as large and diverse as China. Even at a provincial level governments in rapidly urbanizing regions have difficulty maintaining a constant amount of farmland in the face of rapid urbanization. In those regions, demand for land is so high that officials look for various alternative ways to convert farmland into urban uses through the establishment of industrial parks, economic development zones, or high-tech districts, usually on quality farmland areas at the urban fringe.

Additionally, farmland conversion is extremely rewarding for local governments, even in the absence of corruption on the part of individual officials. The profit from the difference between land lease conveyance fees and compensation for farmland conversion can be an important source of municipal government income. Economic growth remains a high national priority for the central government. In many parts of China, economic development cannot occur without farmland conversion. In other words, central government policies send decidedly mixed signals to local governments,

encourage them to use every means at their disposal to promote economic growth and raise revenues to fund infrastructure and public services while at the same time attempting to restrict their use of farmland for these purposes. These signals conflict the most in the parts of China where economic development opportunities are the greatest.

The fundamental problem with these policies is reliance on administrative measures that are simply unenforceable in practice in the face of existing incentive structures. The central government wants local governments to promote economic growth, provide infrastructure and services for a growing population, and exercise sound fiscal management. Under the existing system of land allocation, farmland conversion is the most attractive means of furthering all of these objectives. Recent trends in farmland conversion indicate that the incentives associated with these objectives outweigh the disincentives generated by failing to comply with farmland preservation restrictions.

A more effective approach would be a policy reform program that aligns these incentives as much as possible. The preceding analysis suggests two critical elements of such a program: (1) eliminating arbitrage opportunities from farmland conversion and (2) investing in institutions and infrastructure that maximize comparative advantage across regions. Arbitrage opportunities from farmland can be reduced by liberalizing land markets, including allowing village collectives to lease rural land for industrial, commercial, and residential uses at rental rates set in competitive markets. Arbitrage opportunities can also be reduced by institutional reforms (e.g., tenure security, marketing) and investments in infrastructure (irrigation and drainage, storage, transportation) that increase returns to farming and thus improve farmland retention incentives. These same institutional reforms and investments in infrastructure should

simultaneously help channel land allocation into patterns that exploit comparative advantage in economic activity across regions, allowing China to make the most of its scarce land resources.

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