

Policy Forum on China's Agriculture toward 2030
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Sustainable Agricultural Development

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1. Introduction

The Government of China has determined “sustainable development” as a major national development strategy and has defined environmental protection as basic national policy. To achieve this objective for agriculture and forest sector development, there is a need to balance the economic, ecological, and social aspects of these sectors.

The options for improving productivity per farmer are restricted by limited availability of new arable land, loss of land due to soil degradation and urbanization, and exhaustion of the unused potential for yield increases on the basis of conventional technology.

CHINAGRO analyses policy needs formulated by the Chinese partners that conform to the main goals of agricultural development in China's Agenda 21: (i) to increase farmers' incomes and provide rural employment (social sustainability); (ii) to narrow regional disparity (political sustainability); (iii) to improve resource use efficiency and product quality (economic sustainability); (iv) to arrest environmental degradation (environmental sustainability); and (v) to maintain an adequate self-reliance in food supply (state security). The model-based analysis explores the potential synergies between these goals.

2. Demographic and Socio-economic Development

Due to the inherent demographic momentum, population will grow until 2030 by 12 to 15 percent above the level of 1.275 billion in 2000. Over this period population growth will nearly come to a halt. An important change in lifestyles derives from substantial projected income growth and urbanization. We expect the level of urbanization to reach 60 to 65 percent in 2030 compared to 36 percent in 2000. High economic growth is likely to continue in the coming decades with growth rates gradually reducing gradually over time. The projections in CHINAGRO assume that by 2030, total GDP would reach 5.4 to 7.5 times the size of China's GDP in 2000.

3. Farmland Resources

Arable land has been perceived as the most important resource for China to produce the food for its huge population. In recent years, China's limited farmland resources have been threatened by degradation and by the expansion of non-agricultural land use in response to rapid economic growth and urbanization.

According to the land monitoring data of the Ministry of Land and Resources of China (MLR), in the years between 1987 and 2000, the net decrease (including all forms of losses as well as reclamation) of China's farmland amounted to more than 4 million ha or about 0.3 million ha per year. Several factors led to the loss of farmland, including expansion of built-up land, natural disasters and land degradation, and restructuring of land use patterns in response to market-driven economic incentives. Of the total reduced farmland between 1987 and 2000,

38% was transformed into forestland and grassland for conservation purposes, 25% into orchards and fishponds, and 22% into built-up lands. The remaining part of 15% went to the unused category of land use, as it became unusable due to severe damage by natural hazards. We think these factors will continue to shrink future farmland availability in 2030.

Ecological conversion of farmland

In several provinces of western China, the cultivated land has been largely located on steep mountainous and hilly slopes. The 1998 Yangtze River flooding and recurring droughts in Yellow River basin have heightened public awareness of the severity of Western China's ecological degradation and its dire environmental and economic consequences. The loss of key ecosystem services has resulted in a series of severe off-site environmental and ecological problems. The highly fragile environments of Western regions in China adversely affect the livelihood and welfare of millions of poor farmers and herders, and act as a brake on the progress of economic development in some of China's poorest provinces. Until recently, conversion of sloped farmland into forest, shrub or grassland has been greatly stimulated by the Chinese Government (National Land Conversion Programme, initially called 'Grain for Green').

As Greenland ecosystem services and environmental goods are largely outside the market, the Government has crucial roles to play in combating environmental degradation: to act as a trustee of natural resources; set rules of land conversion program, thereby expressing social willingness-to-pay for ecosystem restoration; support scientific investigation and technological backstopping; coordinate implementation across sectors and administrative levels; provide access to modern technology; foster and facilitate public participation and buy-in; balance stakeholder interests; establish institutional support; create legal frame; enforce environmental regulations; create overall enabling environment; monitor implementation progress; and evaluate program impacts.

In the CHINAGRO central scenario it is assumed that by 2010 all farmland, which occupies slopes steeper than 25°, will be transformed into forest, shrub or grassland.

Farmland loss due to built-up land expansion

Expansion of construction land is acknowledged as an important factor of China's farmland loss and has stimulated great concerns recently. Since this farmland loss was generally located in highly populated urban fringes, it undoubtedly led to a great number of farmers losing their lands.

Regression analyses indicates that the annually increased area of built-up land was highly and positively related to the annual growth rate of GDP and population, and negatively related to the degree of land use efficiency.

Farmland gains

Farmland gains generally come from land reclamation, farmland consolidation, rehabilitation of abandoned farmland and mining sites, and restructuring of agricultural land use. According to the *Land Management Law of P. R. China* and the related regulations, farmland converted into construction land should be fully compensated, i.e., an equivalent amount of farmland to the area converted into built-up land must be obtained by land reclamation, farmland consolidation or rehabilitation.

The feasibility of full compensation of farmland lost to built-up areas is still rather questionable, because it is very expensive; the mean investment of land rehabilitation and consolidation is estimated by the MLR at 0.122 million Yuan per ha. According to the

MLR data, an annual investment of 33 billion Yuan is required to achieve the planned aim of obtaining a farmland area of 0.25 million ha per year in 2001-2010.

The CHINAGRO central scenario assumes that some net losses of farmland are inevitable and that on average only 2/3 of built-up land converted from farmland is compensated with newly gained farmland, as long as reclaimable land is available in a province (based on data of the MLR and agricultural resources survey data of the MOA).

On the basis of available data and projected population and economic development, we estimate the farmland loss due to conversion to built-up land to fall into a range of 6.7 to 9.1 million hectares, i.e., respectively 5.2 to 7.1 percent of the total farmland in 2000. These average figures mask a great variation among regions. The highest percentage conversion to built-up land is estimated for the South (17 to 25 percent) and East (12 to 17 percent) regions. Conversion of less than 5 percent of total farmland in year 2000 is projected for all other regions, except the North region (6 to 8 percent).

Taking various forms of conversion into account (including ecological conversion, conversion to orchards and fishponds, loss due to natural hazards and degradation), we estimate that China's farmland will decrease from its year 2000 level of 128.2 million hectares to a range of 118.0 to 120.2 million hectares in 2020, and a range of 113.6 to 117.8 million hectares by 2030, i.e., a possible net reduction of 8.2 to 11.4 percent over 30 years.

Irrigated farmland

Nearly 45 percent of China's farmland is irrigated. Irrigation water is essential for China's high output from limited farmland. From county-level data of year 2000 on crop cultivation and production we estimate that 54 percent of all sown area in China is on irrigated land (due to superior multi-cropping conditions). There is a wide variation in this share among regions due to diverse environmental conditions. The highest estimate was obtained for the East region (74 percent), the lowest for Northeast (21 percent).

Furthermore, we estimate that irrigated land uses 60 percent of farm labor in cropping and over 70 percent of chemical fertilizers and farm machinery used in cropping.

We estimate that 72 percent of grain output is produced on irrigated land. For rice, the share contributed from irrigated land is well over 90 percent, for wheat more than 85 percent. On the other hand, major feed commodities, maize (45 percent from irrigated land) and soybeans (< 30 percent from irrigated land), currently come from dominantly rain-fed production.

Regarding the change of irrigation areas in the next 30 years, the proportion of irrigated farmland in the Northeast is likely to increase, because this is a major grain producing area with plenty of water available and currently with the lowest rate of irrigation of all regions. For the North, water availability is a pressing problem due to increasing non-agricultural water demand. For the coastal provinces of the South region, a decreasing rate of irrigation area is mainly due to farmland conversion to built-up land. For the remaining regions, we expect that the current rate of irrigation can be maintained. In total, the baseline scenario projects little change of irrigated area (although some changes in distribution among regions). As water supply available for agriculture will be stagnant or even declining in the future, the key to maintaining or even expanding irrigated areas lies in more rational and efficient use of water.

4. Livestock intensification

Over the last 20 years, China's demand and production of livestock products has increased remarkably due to rapid development of the national economy, rising living standards, and population growth. Meat consumption has not only increased in volume but also changed in composition to satisfy demands in higher quality-lower fat products. In particular, between 1980 and 1999, poultry production increased 4.7 times while pork production increased about 2.2 times (CCAP, 2002). Between 1990 and 1999, per capita consumption of pork increased by roughly 30 percent, per capita consumption of poultry meat more than doubled. Poultry now accounts for about 21 percent of total meat production in China. In other words, Chinese consumers are gradually shifting from pork consumption to more poultry and aquatic products. Yet, at present, pork still accounts for about two-thirds of total meat consumption.

To meet the growing meat demand, China as many other countries, is rapidly moving from traditional natural resource based management to intensified peri-urban and urban production systems. Geographical shifts are further determined by changes in infrastructure, availability and economics of feed supplies, and by relative prices for land, labor and capital. This transition has had profound enhancing effects on the industry's performance.

China is among the countries with the highest densities of pigs and poultry in the world. The vast majority of animals is distributed in small traditional holdings. In terms of monogastric animal stocks China ranks first in the world. According to the 1997 Agricultural National Census of China, 335 million pigs and 2.7 billion fowls were kept respectively in 130 million holdings with pigs and 144 million with poultry. In 2000, traditional backyard systems accounted for about 60 percent of pork production and 40 percent came from specialized and intensified systems.

The results obtained in CHINAGRO clearly show that the increasing meat demand can only be met through rapid introduction of intensified livestock systems. Pig stocks in intensified systems are expected to increase at least 3 to 3.5 times, broilers 4.4 to 5 times, and layers 2 to 2.4 times. With demographic changes and urbanization, backyard systems will not only decline as percentage of the total, but also decrease in absolute numbers. The CHINAGRO analysis projects that pigs in traditional systems are likely to account for less than 1/3, broilers for 10 to 20 percent, and traditional layers for 20 to 30 percent of total stocks in 2030.

Environmental and health risks

The choice of options how to expand livestock production determines the vulnerability of socio-economic and environmental systems towards disease risk. The geographical distribution of livestock and intensification levels also determine environmental impacts through nutrient burden from concentrated pig and poultry systems, where insufficient land is available for manure disposal and recycling, causing land and water pollution.

Intensification and concentration of livestock production is causing massive waste management problems. Without appropriate treatment this will inevitably increase environmental and human health risks. Environmental impacts are mainly associated with mismanagement of animal excreta leading to significant pollution of surface and groundwater, emissions of manure-related gasses into the atmosphere (methane, nitric and nitrous oxide, etc.), and overload of soils by nutrients.

Problems of environmental pollution and soil loads from intensive livestock production are magnified by concurrent increase of chemical fertilizers use associated with intensifying crop production. China is the world's largest consumer of fertilizers accounting for about a quarter of total world consumption (International Fertilizer Association, 2004).

Detailed nutrient supply and uptake calculations show that nitrogen uptake by crop and fruit production in 2000 amounted on average to 110 kg N per hectare of cultivated and orchard land. Due agro-ecological conditions, the province averages vary in the range of 50 kg N per hectare (e.g. Southwest) up to 200 kg N per hectare (e.g. Jiangsu province). In total we estimate that crop production in 2000 has taken up about 16 million tons of nitrogen. This compares to about 24.5 million tons of nitrogen supplied by chemical fertilizer use and an estimated 8 million tons of N in livestock manure. Hence, the nitrogen released to the environment amounts to about 20 kg N per hectare of total land. For Jiangsu, Zhejiang, Henan and Hubei this value is well over 100 kg N per hectare implying a very substantial environmental pressure on soils and watercourses.

Due to further intensification of agricultural production in both crop and livestock sectors, we estimate that with current rates of efficiency the environmental load stemming from nitrogen cycles would increase by about 33 percent, indicating the importance of improved fertilizer use efficiency and better ways of livestock manure treatment and recycling.

5. Policy conclusions

From the model-based analysis carried out in CHINAGRO we can summarize a few policy relevant conclusions discussed in this briefing note:

- Having many more and wealthier consumers in urban conditions will have profound impacts on demand. We expect human grain consumption to remain relatively stable whereas consumption of livestock and fish products will approximately double, with major implications for agriculture development.
- Economic growth and urbanization will forcefully compete for agricultural resources of land and water. We estimate that another 7 to 9 million hectares of farmland will be converted to built-up land up to 2030, i.e., 5 to 7 percent of farmland in year 2000. The effect will be much larger for the South (17 to 25 percent) and the East (12 to 17 percent) regions.
- As greenland ecosystem services and environmental goods are largely outside the market, the Government has crucial roles to play in combating environmental degradation.
- Despite of current legislation and efforts, we expect that no all conversion to built-up land can be compensated by reclamation and restoration. It is estimated that the stock of farmland in 2030 would be in the range of 113 to 118 million hectares compared to 128 million hectares in 2000.
- We estimate that 72 percent of grain output in 2000 is produced on irrigated land. For rice, the share contributed from irrigated land is well over 90 percent, for wheat more than 85 percent. On the other hand, major feed commodities, maize (45 percent from irrigated land) and soybeans (< 30 percent from irrigated land), currently come from dominantly rain-fed production.

- Irrigation water is essential for China's high grain output from limited farmland. As water supply available for agriculture will be stagnant or even declining in the future, the key to maintaining or even expanding irrigated areas lies in more rational and efficient use of water.
- The increasing meat demand can only be met through rapid introduction of intensified livestock systems. Pig stocks in intensified systems are expected to increase at least 3 to 3.5 times, broilers 4.4 to 5 times, and layers 2 to 2.4 times.
- Due to further intensification of agricultural production in both crop and livestock sectors, we estimate that with current rates of efficiency the environmental pressures stemming from nutrient concentration and overload would increase by about 33 percent. It is of high importance to improve fertilizer use efficiency and balance of nutrients, and to plan for environmentally adequate ways of livestock manure treatment and recycling.