

The Sustainability Issues of Chinese Food Security in the Context of Industrialization and Urbanization

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Abstract

Nowadays, Chinese agricultural production are relied more on the female and the elder famer as a result of many male workforces from rural village move to urban cities. Due to the migration of the energetic workforce from rural village, a large amount of fertile land was abandoned. In addition to the shortage of labor force, more and more cultivated land and water resources occupied by the construction of manufacture and infrastructure during the process of industrialization. Since the population of China will continue to increase until 2030 and with the improvement of the people's living standard, more demand for food is inevitable in the coming decades. Even today china can supply enough food to meet the demand. However, in the long run the food security problem will happen unless some necessary actions are taken now.

Introduction

People take food as their first need, and an old Chinese saying that with food in hands then there is no need to panic. In order to get enough food and avoid hunger, human being worked for it generation after generation by expanding the planting area and irrigation area, and by improving the planting technology and cultivating high yield seed. The Communist Party of China (CPC) attached importance to the issues of food security from the beginning of the foundation of the People's Republic of China (PRC), and took the food production as the key link of agriculture development. The purpose of the construction of irrigation system across the whole country after "the Great Cultural Revolution" is to achieve food self-sufficiency.

The concept of "food security" was first put forward by the UN's Food and Agriculture Organization (FAO) at the Roman world food assembly in November of 1974, on the conference food security was defined as "ensure that anybody at any time all has the ability to get enough food for survive and health needed". With the world economic, social, diet culture and the condition of food demand and supply changed, FAO corrected its

definition of food security in 1983. “the ultimate goal of food security is to ensure that all the people at any time can afford and get basic food they need”. (Ding Shengjun & Zhu Lizhi, 2003) In 2000, the FAO give the “Food security” the third definition that “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” (FAO, 2000) Chinese scholar Wu Zhihua et. al (2001) integrated the definition by FAO with China’s real food situation and give the food security definition as: “in order to ensure that anybody at any time within a country or region can get enough food for survival and certain health level, then the government should have the ability to manage effectively of food production, circulation and consumption. This study focus on China’s sustainability issues of food production security based on the analysis of variables which most impact Chinese food production.

Since the decollectivisation and introduction of Deng’s “household-contract responsibility system” by CPC at the end of 1970s, rural land has been distributed and held by individual families. The adoption of this policy stimulated hundreds of millions farmers’ production enthusiasm, and it paved the way for rural reform and development in China. (Chen Hualin, 2002) In addition, it also brought the rapid development of Chinese agricultural production, the rapid improvement of the household income of the peasant. (Wang Lei, 2012) According to the data from the national statistics bureau (2010) the total food yield doubled within a decade after 1978. More specifically, China’s food production is 400 billion kilogram in 1978 and it increased to 800 billion kilogram upto 1988.¹⁾ However, as the dividend of this policy gradually released, the deficiencies of this policy getting more and more obvious with the industrilizaion deepening. (Liu, Wenbi, 2009) Such as the fragmentation of farmland management which makes it difficult to achieve scale economy. Moreover, the individual family only have the right to cultivate the land

1) **Food yield** refers to the yield in the whole country including grains produced by state farms, collective units, industrial enterprises and mines. **Food** includes rice, wheat, corn, sorghum, millet and other miscellaneous grains as well as tubers and beans. Output of beans refers to dry beans without pods. The output of tubers (sweet potatoes and potatoes, not including taros and cassava) was converted into that of grain at the ratio 4 : 1, i.e. 4 kilograms of fresh tubers was equivalent to 1 kilogram of grain up to 1963. Since 1964 the ratio for conversion has been 5 : 1. Tubers supplied as vegetables (such as potatoes) in cities and suburbs are calculated as fresh vegetables and their output is not included in the output of grain. Output of all other grains refers to husked grain. **Source** : National Bureau of Statistics of China. Definition. 2002.

http://www.stats.gov.cn/english/classificationsmethods/definitions/t20020517_402787575.htm. (accessed on August of 2012).

Note : National Bureau of Statistics of China use “Grain yield”, but in order to consistent with “food security” so in this paper we replace it with “food yield”, “food output” or “food production”.

and the ownership right still belongs to the village collective, hence the land cannot trade freely as other resources and it caused the lower comparative benefit of the rural land. (Wang Yue & Chen Zhanjiang, 2005)

In the early days after the foundation of PRC, because of the shortage of food, housing and jobs in urban cities. In order to control the population scale in city the central government had established the system of registered permanent residence (Hukou). It divided the population into two parts— rural registered residence and urban citizen. (Sun Liping, 2003) The regulation system without any improvement until 1980s after China started to reform and open-up, and the establishment of a working group for reforming Chinese household registration system in 1992 implies the senior government try to change the exist household registration system.

However, the reformation of the system in many metropolis tend to add some certain special conditions, and in some cities the reformation of the household registration system only for high-end talent whom those cities are in urgent needed. And to date, the reform did not improve the position of ordinary rural population obviously. (Wang Guixin & Wu Junkui, 2011) So, until today most of rural migrant worker in cities without urban citizenship, and they have no chance to get kinds of social welfares which the urban citizenship enjoyed. To say at least, the strict urban-rural dual household registration system artificially intensified the gap between urban and rural areas. (Sun Liping, 2003) In addition, it also causes rural hollowing, aging farming and shortage of labor force during busy farming season ; on the other hand, the migrant workers have no citizenship in urban cities, and they must like migratory birds move between rural and urban year by year, and the endless moving not only increased their living cost but also caused the problem of pseudo-urbanization in many big cities today. (Wang Chunguang, 2006)

On one hand, As more and more rural labor forces have been flowing into cities, the problem of agriculture labor shortage will be more obvious. It likely causes the abandonment and extensive planting of arable land. In addition, the arable land resource is decresing with the construction of urbanization and industrialization. According to the calculation of Qu Geping (2004), the construction occupied 1.23 million hectares of farmland between 2001 and 2010, and it will continue to take up farmland amount to 2.40 million hectares from 2011 to 2030. On the other hand, China has more than 1.3 billion people and the population will grow to its peak of 1.6 billion by the year of 2030.²⁾ It implies that in the coming decades the cultivated land resource and labor forces is

2) The Information Office of the State Council of the People'S Republic of China. *Chinese Food Issues (Zhongguo de Liangshi Wenti)*. Beijing: People's Publishing House, 1996.

decreasing while the food demand is growing rigidly. Hence, even today we can supply enough food,³⁾ but in the long run more attention need to be paid to the issues of food security. The purpose of this study try to find out the fundamental factors which important to food production and propound some specific policy recommendations on how to achieve the goal of food security in China

The Current Situation and Proplems of China's Food Security

There are many standards for assessing the situation of certain country's food security. The most authoritative and widely used indices which focus on food production field in China were defined by Rural Socio-economic Investigation Department of the National Bureau of Statistics (2005). Several basic lines were setted in this definition, such as per capita food sowing areas should more than 1.2 mu,⁴⁾ the effective irrigation areas should more than 60% of total cultivated areas, the degree of food net import dependence can only around 5%, the ratio of state food reserve should higher than 20%, food storage per rural household should around 250 kilograms, and other quantitative indices. In addition, some other mensurement indicators like "food self-sufficiency rate", "per capita food possession", and "fluctuation coefficient of food production"also were widely used. (Ou Xuan & Hou Jie, 2010) Zhu Ze (1998) created a comprehensive index named "food security coefficient" by assigning different weight coefficients of 0.2, 0.1, 0.4 and 0.3 respectively to "food reserve ratio", "food self-sufficiency rate", "per capita food possession", and "fluctuation coefficient of food production", then he calculated and compared China's food security cofficient (0.70) with American (0.82), Canadian (0.91), French (0.88) and other countries. And he found that China's food security situation is worse than these countries. In this study we will only take index of "400 kilogram per capita food possession" as the only standard for estimating the situation of China's food security.

1. Real Situation of Chinese Food Production in the New Millenium

In spite of China's food output has been increasing in the past eight years since the year of 2004 but as the population growing and the people's living standard improving more food will be consumed and per capita food consumption will growth too. Wang

3) According to the national statistics data the food output per capita in 2010 and 2011 are more than 400 kilograms, and it is considered as a safety situation in China's development stage, more information about China's food production per capita please refer to Figure 2.

4) mu, a unit for measure land area in China, and 1 mu equal to 1/15 hectare (666.7 m²).

Chuanshi and Sun Ruiling (2003) did an empirical study on the relationship between people's food consumption structure and their income level within 31 Chinese provinces (including municipalities and autonomous regions but excludes Hongkong, Macao and Taiwan). They found that as people gain higher income and they consumed more dairy, meat, liquor and other energy-dense food than their counterpart who earned less income in 2001. Ma Xiaohe (1997) argued that as China's population urbanization increasing by one percent and it will lead to increase another 1054 tons of food consumption, in addition, he pointed out that Chinese people will consume another 430 tones food as long as China's GNP per capita increased ten percent. According to the estimation from the white book of *Chinese Food Issues* (1996) that Chinese population will reach its peak of 1.6 billion in 2030, and per capita food consumption is 400 kilogram. By then, Chinese total food consumption will reach up to 640 million tons. The data from National Bureau of Statistics shows that China's food total production in 2011 was 570 million tons. And if we don't consider the influence of food import and the progress of agricultural technology, then in the coming 19 years we need to produce 3.5 million tons more food year by year, and it means we need to plant another 0.7 million hectares⁵⁾ food to meet the demand.

2. Situation of Water Resource

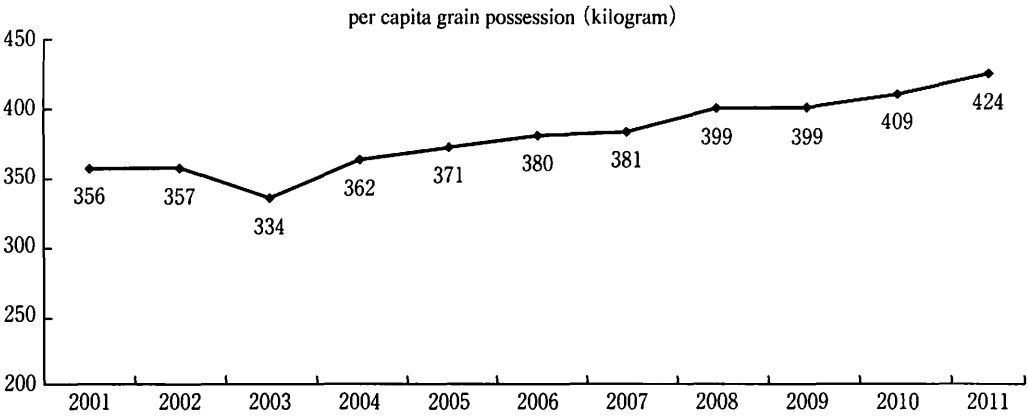
In China the total cultivated land area was 121.7 million hectares, and the effective irrigated area was about 58.5 million hectares by the end of 2008.⁶⁾ It is easy to make out that the national average irrigation rate was only 48% in 2008, and this is obviously lower than 60% which setted by the Rural Socio-economic Investigation Department of the National Bureau of Statistics. As Figure 2 shows that the effective irrigation area of cultivated land increased 8 million hectares during the past 11 years. Because of the dispositional distribution of cultivated land resource and fresh water resource in China, large amount of increased irrigation areas in north China were relied on groundwater.

The grain yield is threatened heavily because shortage of fresh water resource recently. The water resource in China is not only scarce but also uneven distributed. "the thirst North"— north of the Yangtze River own two thirds of total cultivated land resources, but it only has one fifth of total freshwater resources. Even take "the humid South"into account, Chinese per capita fresh water possession is less than 40% of the world's average

5) According to the national data of 2010 we can work out that the national average yield of food is 4.97 tons per hectare, since the total yield was 546.48 million tons and the total planting area was 109.88 million hectares in 2010.

6) Source : the National Bureau of Statistics of P.R.C. China Statistical Yearbook 2010.

Figure 1 Chinese Per Capita Food Production from Year of 2001 to 2011



Data source : the National Bureau of Statistics. China Statistical Yearbook 2006 & 2011.

Note : since it is very difficult to get the data of " per capita food possession" so in this study we replace it by using "per capita food production", and it equal to national total food production divided by the population at the end of the same year.

Note : all Tables and Figures in this article were created by the author.

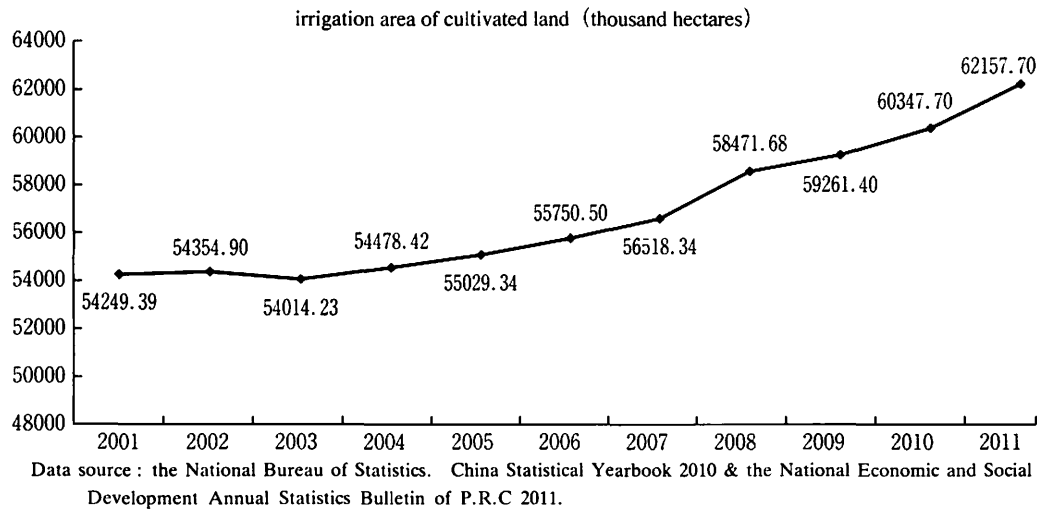
level. (Xu Feng, 2009) Except for huge cultivated land has been taken over for factory and housing, large amount of water also has been wasted and polluted during the process of industrialization and urbanization. In China the industrial water use accounted for 10.3% of total water use in 1980, but it jump to 24.1% in 2007. Meanwhile, the consumption of one urban citizen's domestic water per day from 120.6 litre increased to 178.4 litre. (Yang Guoqiang, 2009) The news about the mining factories scramble water resource with local farmer and herdsman in villages of Inner Mongolia happened oftentimes during the dry season, and water pollution events can be heard almost everyday in China.

Figure 1 and Figure 2 inform that as the cultivated land resource decreasing, the improvement of China's food output is mainly attributed to the increase of irrigation area in the past 11 years. However, whether this sustainable is questionable since several north agricultural provinces with pumping their groundwater for grain harvest. On the other hand, global climate is changing, and this area becoming more and more drier, if there is enough rain the groundwater resources will be used out some day.

3. The Cultivated Land Resources

Food is the paramount necessity of the people, and the land is the basic material for producing food. The cultivated land area has been decreasing with the development of industrialization and urbanization since 1990s in China. (Zhang Yanlin, 2010) The data of the National Bureau of Statistics of P. R. C shows that during 1996 and 2006 China's cultivated land area has decreased from 1.951 billion mu to 1.827 billion mu, and it

Figure 2 Changes of Chinese Effective Irrigation Area of Cultivated Land from 2001 to 2011



continued to decrease another million mu during 2006 and 2008. Qu Geping (2004) pointed out that China will continue to lose 7.73 million hectares of its cultivated land area from 2011 to 2030. The contradiction of huge population with relatively small amount of land is getting worse.

According to the data from national bureau of statistics, China had 1.826 billion mu cultivated land and total planting area is 2.344 billion mu in the year of 2008. We can work out that the multi-cropping index of the cultivated land is 1.28 (2.344 divided by 1.826). The statistic data also shows that the grain sowing area accounts for 60% of total cropping area in 2008, and the sowing area is 1.602 billion mu.

The information of Table 1 tells that the increase of China's total food output between 2001 and 2011 not mainly because of the expand of grain sowing area but owe to the increase of more fertilizer input and the increase of irrigation area of cultivated land. Besides, the relationship between the curves of fertilizer input per unit sowing area and grain output per unit area from 2001 to 2011 in Figure 3, tells that the increasing proportion of fertilizer input is higher than the proportion of the increase of total grain output in the meantime. In other words, the marginal utility of fertilizer input is declining or even it is no obvious effect.

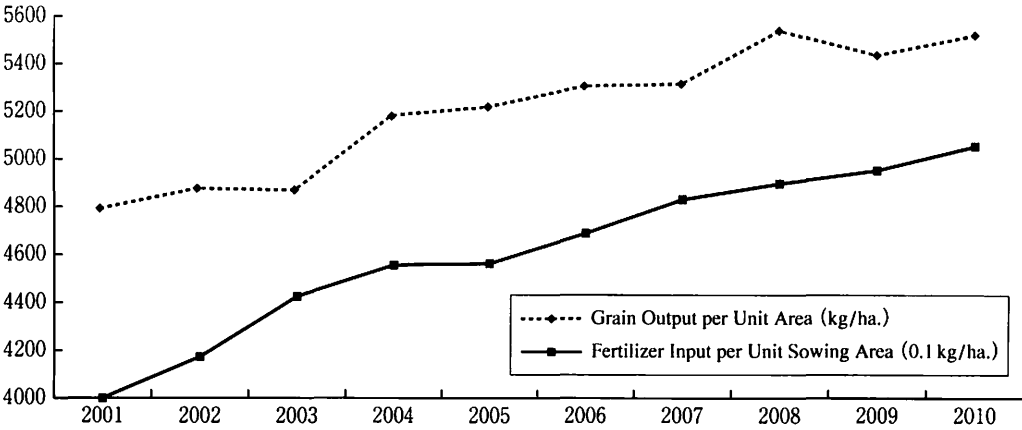
In addition to the decrease of the cultivated land area, low multi-cropping index of cultivated land is another important factor which decreased the utilization rate of the land in China. Zhu Qizhen and Zhao Chenming (2011) found that there are two kinds of situation maily cause the problem of land abandoned. The first kind is called "ability not meet with one's ambition, then just grow enough food to feed family member". In other

Table 1 Information of Food Output, Grain Sowing Area, Amount of Fertilizer Input, and Effective Irrigation Area of Cultivated Land of China in the Year of 2001 and 2010

Item (unit)	2001	2010	Net increase	Average annual growth rate
Total Food Output (million tons)	452.637	546.477	93.840	1.9%
Total Grain Sowing Area (million hectares)	106.080	109.876	3.796	0.4%
Total Fertilizer Input (million tons)	42.538	55.617	13.079	2.7%
Cultivated Land Irrigation Area (million hectares)	54.249	60.348	6.098	1.1%

Data source : the National Bureau of Statistics, the National Economic and Social Development Annual Statistics Bulletin of P.R.C 2011.

Figure 3 The Change Curves of Grain Output per Unit Area and Fertilizer Input per Unit Sowing Area of China between 2001 and 2010

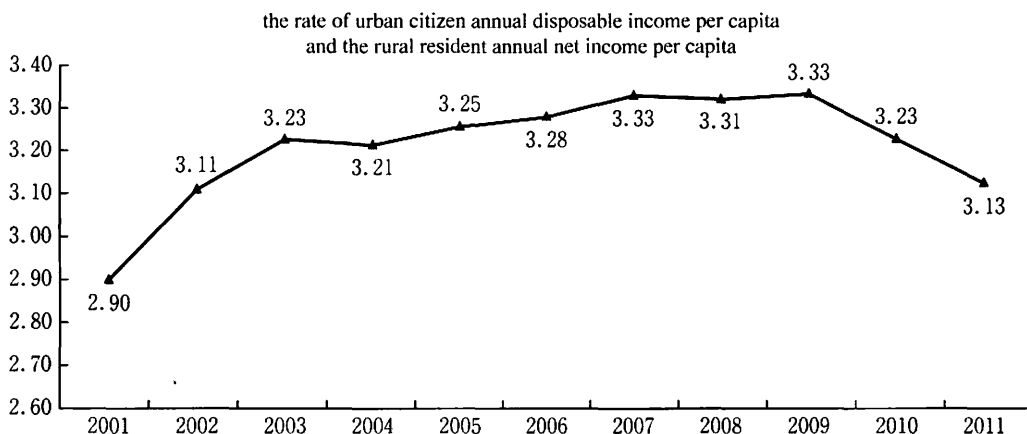


Data source : the National Bureau of Statistics. China Statistical Yearbook 2010 & 2011.

words, even some peasants want to grow more food but due to the lack of labor force, financial capital or other resources, actually they cannot grow more food then they did. The second kind is called “the heart is not on the land”. This situation is very popular among peasants, since many of them consider that farming makes no money.

4. The Outflow of Rural Labor Force and Aging Farming

It is an indisputable fact that the income gap between urban and rural has increased in the past decades. Figure 4 shows that annual per capita disposable incomes of urban citizen keeping with more than triple of the rural resident’s annual net income per capita since 2002. In spite of both the local government and the central government increased the investment to agriculture and increased the transfer payment to the rural area. It did

Figure 4 The Rate of Urban Citizen Annual Disposable Income Per Capita and the Rural Resident Annual Net Income Per Capita between 2001 and 2011 of China

Data source : the National Bureau of Statistics. the National Economic and Social Development Annual Statistics Bulletin of P.R.C 2005 & 2011.

reverse the the trend of widening income gap between urban and rural in China. But by the end of 2011 the gap still higher than three times, and it still worse than the situation of 2001 (2.90 times). If deduct remittances which the rural migrant worker earned in urban cities and send them home for their rural family members, then the real gap between urban and rural will be much larger. The big income gap between urban and rural is the primary cause of outflow of the rural labor force.

As for agricultural aging and feminization the author have profound experience. In September of 2009 the author did a field research at two rural villages in Jiangxi province that random sampled 60 households from each village and total amount is 120 households. Among the 120 households there were 558 permanent residents,⁷⁾ including 380 labor forces and semi-able-bodied labor forces⁸⁾, and the remainder are school students, pre-school children, the old and the disabled. Only 170 of the 380 are full-time farmers, and their average age is 53. In contrast, the average age of 145 migrant labors who worked in urban cities is only 30. Furthermore, among the 170 full-time farmers there are 116 women, it accounts 68.2% , but among the 145 migrant labors only have 41 women and it make up only 28.3%. In short, this case shows that most of young labor forces and especially the young male labor forces move from rural village to urban cities and left the old, female, children and the disabled in the rural village. (Fu Gonghua, 2010)

To see from nationwide, the data from the National Bureau of Statistic of China

7) In this study, the permanent resident refers to the resident who live in the rural village more than six months a year (more than half year live in the rural village).

8) Semi-able-bodied labor force refer primarily to the labor who are 65 years or older.

shows the number of employments in the first industry (mainly agriculture) is 363.99 million in 2001, and it accounts half of total employments. The employments of the first industry drop to 279.31 million in 2010, a decline of 23% within the decade. In the meantime, the level of national population urbanization only increased 174.93 million, rose by 12%. It is clear that more and more rural labor forces migrant to urban cities in the past decade. Furthermore, *the National Economic and Social Development Annual Statistics Bulletin 2011* showed that the total migrant population of China is 230 million in 2011.

The study of Wang Xiwei (2007) also verified the problem, she found that among the total rural migrant labor forces the male took up for 63.3%, and female make up the remaining 36.7%. Her study also found that 52.6% of the rural migrant labor forces no longer make any agricultural activities. The data from FAO shows that the world average usage of agricultural tractor every hectare was 20, and the usage of combine harvester was 3 in 2006, but in China the numbers respectively were 15 and 0.5⁹⁾ in the same year. The comparison informs that the gap of agricultural mechanization is clear between China and the world average level. Therefore, the influence of labor force input on food production in China is more sensitive than the world average level, and to improve food production the labor force input in China is more important than many other countries. Because of weak with age the farm work that young people can complete within one day the old farmer often need two days or more. The lacks of energetic labor force in agriculture may lead to miss the proper farming time and reduce the yield. The agricultural production in China is facing the adverse condition that "the young are not willing to farming, and the old are too old to farming".

5. The Risk of Food Production

The risk index of food production equal to the total input (cost) divided by the expected income of the same amount of food. To the modern rational peasant agricultural production activities is also regarded as an kind of investment. Before the investment the farmer have to estimate its expected income and risk. If the risk index equal to one it means the investment of food production just in the balance point of profit and loss (break-even point), and if it is greater than one, it means produce food will loss. So, the peasant only expand investment in food production when the risk index is less

9) *China Rural Statistical Yearbook 2009* shows that total agricultural tractor (including large and small tractors) is 17397274, the number of combine harvester is 565578, and the cultivated land area is 1141875 thousand hectares of China in 2006.

than one.

As discussed above, with the diminishing marginal returns of the chemical fertilizer and the decreasing of the cultivated land. The increase of food production in the future will mainly rely on the expansion of the irrigation area and increase the multi-cropping index. But these ways need huge investment, and it will increase the marginal cost of food production. Furthermore, the opportunity cost of food production will increase with the widening of the income gap between urban and rural. Therefore, the gross cost of food production will increase with the increase investment in improving the irrigation system and the increase of the labor price. The traditional comparative advantage of food production in China may disappear. On the other hand, due to the rigid characteristic of food consumption. It often manifest the character of "high value but low price". Zhu Qizhen and Lu Kerong (2007) considered that farming could not improve the farmer's income level and the rising costs with fluctuating returns lead to high risk of food production and low enthusiasm of farming investment.

All in all, both the attractive force from the high salary of working in urban, and the push from the low return of farming in the rural village are forcing rural labor force to leave their land for urban cities. It will not only cause the loss of large amount of agricultural labor force in rural villages but also bring about the problem of semi-urbanization in urban cities because of a mass of migrant population is "floating" there.

Policy Recommendation

Agriculture is the basis of economic development, social stability and national independence for any country, and it especially important for the large country of population as China. According to the previous analysis, there are mainly five difficulties of food security in China. Firstly, the decreasing of cultivated land area and the decline of multi-cropping index; Secondly, the lack of and the imbalance distribution of water resource caused the expansion of irrigation area difficultly and costly; Thirdly, although the usage of chemical fertilizer improved the grain yield greatly but its marginal effect is diminishing; Fourthly, a great number of rural labor forces leaved their land for urban works exacerbate the situation of aging farming, rural hollowing and shortage of agricultural labor; Finally, the unprofitable farming and increasing risk of food production lead to fewer and fewer farmers willing to stay in the rural village for farming. In front of these difficulties our job is not to wait the situation go worse but have to think ways to solve the problems. The central government had released 9 pieces of the Central First Document about "peasantry,

countryside and agriculture issues of China” during the first twelve years in the 21st century. It clearly stated that the top leaders had already aware of the seriousness of the food security problems. It is certain that suit the remedy to the case can help to solve the problem more effective. Therefore, some popular viewpoints need to be corrected before giving the policy recommendation.

The first popular viewpoint which need to be corrected is the theory of surplus labor force in agriculture. Actually, it is not the surplus of rural labor forces but the surplus of their spare time in the current China. There is no surplus labors in rural village during the busy farming season. The rural labor migrated to urban cities during the slack farming season and most of them didn't come back to the rural village when the busy time coming, and it cause the problem of labor shortage in agriculture. The shortage of labor force during the busy time in rural area proved that the surplus in rural village is not labor forces but farmers' spare time. If this viewpoint still held to be true then the rural areas may only left the wasted land without farmers in the near future.

The second viewpoint which need to be changed is that more chemical fertilizer investment can harvest more food. Since the marginal return of the fertilizer diminishing, more fertilizer input may not lead to more harvest but more pollution and damage of the ecological environment.

The third viewpoint which need to be rectified is the traditional theory of labor benefit maximization. Compare with the huge population need feed, and the cultivated land resource is very limited in China. So, in order to ensure food security we cannot chase for the labor benefit maximization as America or Canada but should make the best use of our cultivated land.

Based on the analysis of the situation of food security and the reflection of some popular viewpoints, several suggestions can be proposed against the problems of food security in China. First of all, in order to detain enough labor force to grow food, the infrastructure such as road, irrigation system and rural market construction should be improved in the rural areas. It is the very time to provide the farmer with necessary welfare and facilities, and narrow the gap between urban and rural. In addition, try to eliminate the difference between urban and rural from farmer's psychological to change the the negative preconception about farming.

Secondly, the urban-rural dual household register system should be abolished to enable the people free migration between urban and rural. By the purpose of making the best of the land resource the institution of land need to be improved, and the new institution should encourage the land can be free circulation within the rural village. For

example, if some households want to move to urban cities then their land use right must be sold to other farmers who want to cultivate.

Thirdly, in order to encourage the farmer to grow more food the government should strengthen the policy of supporting agriculture and benefiting the farmer. High risk but low returns of farming cause farmers unwilling to work on land. According to Schultz's "rational peasant theory",¹⁰⁾ if the returns of farming is less than other works then the farmer will give up farming. Therefore, the government can keep farmers on their land through giving agricultural subsidies, and the amount of subsidy must can make up for the income gap between farming and the average wage in society theoretically.

Fourthly, it is the very time to speed up the pace of the investment in the construction of irrigation and water conservancy facilities, particularly the South-to-North water diversion project. Since the increase of irrigation area can improve the food production significantly. Therefore expand the irrigation area is one of the best and feasible way to ensure food security in China.

The last but not the least, expanding international cooperation and to make good use of both domestic and international markets for our food security. China has relative advanced agricultural technology and human resource, while Africa has huge arable land resource but shortage of technology and finance capital. So, carry out of agricultural cooperation between China and Africa can improve food security level for both sides. Today, as the deepening of global trade liberalization and international specialization, more and more resources are allocated by global market. It can improve the efficiency of resource use and the total benefit of human being. Today, China is "the factory of the world", and Africa can be "the granary of the world" in the future based on its huge arable resource. China can decrease its cost of food self-sufficiency by growing or importing food from Africa as a supplement solution of food security of China. To African countries, cooperation with China in agriculture can improve their food self-sufficiency level and reduce the dependency on import.

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