Fruit Production Distribution and Adjustment Strategies under the Constraint of Grain Security

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Abstract Grain security is the foundation of national security, and guaranteeing the grain security by every possible means is a development priority for the whole country. Rapid development of the fruit industry satisfies increasing demands of people for fruits, but also presents certain competition for grain production. From the perspective of limited resources and comparative income, this paper analyzed potential threats of fruit production distribution to grain production in farmland and labor resources, and came up with pertinent adjustment strategies.

Key words Grain security, Fruit, Production distribution, Adjustment strategies

1 Introduction

For a long time, China has been attaching great importance to the grain security and always places the grain security in a strategic position. In 1998 - 2003, China's grain yield dropped substantially, per capita share of grain declined, and grain price rose by a wide margin, making the grain security attract wide concern[1]. After 2003, with great support of preferential policies, China's grain yield realized the increase for 12 consecutive years. In 2014, the total grain yield reached 621.435 million tons, increasing 2.4% compared with 2013, which alleviates the pressure of grain security to a certain extent. However, it should be clearly aware of potential threats of the grain security. At the same time, driven by comparative income and efforts of government in promoting increase of farmers' income, most areas start to develop fruits, vegetables and other non-grain crops, leading to greater shortage of scarce resources and elements. In this situation, from the perspective of limited resources and comparative income, we analyzed potential threats of fruit production distribution to grain production in farmland and labor resources, and came up with pertinent adjustment strategies.

2 China's grain security situation is not optimistic

Grain security is always a major issue with high concern. From the perspective of development, the conflict between continuous growth of grain demands and slow growth of grain supply is still outstanding and will exist for a long time, thus China's grain security situation is not optimistic. From the perspective of grain demands, China remains the important period of accelerating industrialization and urbanization. With increase of population, rise of proportion of urban population, rise of resident consumption level, and continuous increase of grain for industrial, feed and biomass energy resources, China's grain demands are showing rigid growth. Calculated as per annual net increase of 8 million to 10 million and annual increase of urban population of 20 million (including 8.4 million migrant workers), annual increase of grain demands is about 3.5 - 4.0 billion kg[2]. Besides, with constant acceleration of urbanization and continuous rise of resident consumption level, people's demands for meat, egg and milk will significantly increase, which will need more grain conversion; according to statistics, the feed grain increases at annual rate of 3%[3]. In addition, constant development of grain processing industry and urgent demands for biomass energy contribute to substantial increase of demands for maize and soybean. Conversely, due to resource constraint of farmland, water and labor, as well as limitation of climate, science and technology, and international trade environment, China's grain supply has a high difficulty in keeping stability and constant increase. Firstly, constant shrinkage of farmland area is a primary factor restricting grain production. China remains at the accelerated period of industrialization and urbanization, farmland resources are increasingly subject to economic competition of industrial and urban land use, and the trend of non-agricultural land use of some farmland will not be reversed. According to statistics, China's farmland area dropped from 130 million ha in 1996 to 122 million in 2006, reducing about 80 million ha within 10 years. Although China implemented most strict farmland protection system since 2006, the rate of shrinkage of farmland declines, but there is still farmland converted to non-agricultural land use every. Due to influence of social economic transformation, structural adjustment and land circulation reform, the problem of deserting farmland is of frequent occurrence, which will greatly reduce integrated production capacity of grain. At current stage, water resource quantity per unit area of farmland is 80% of the world average level, and water resource quantity per unit area of irrigation is only 19% of world average level[4]. At the limited total water resources, the proportion of agricultural water consumption to total water consumption is declining (from 63.60% in 2005 to 61.30% in 2010). However, in the same period, domestic water and industrial water consumption constantly increased. In these 6 years, the proportion of domestic water and industrial wa-

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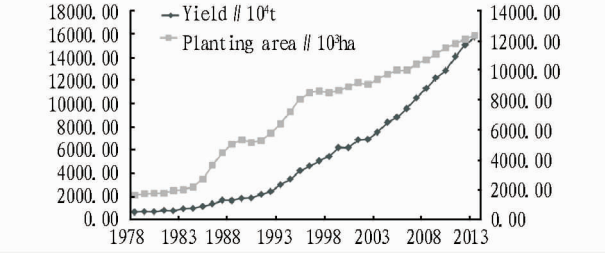
ter consumption to total water consumption increased 0.70% and 1.20% respectively. With acceleration of urbanization process and constant development of industries, the conflict between agricultural water consumption and non-agricultural water consumption will be further aggravated. Furthermore, under the inducement of higher non – agricultural employment income and eagerness for urban life, numerous rural labors flow to non – agricultural sectors, and such process is difficult to repress in a short term. Loss of rural labors, especially young and middle – aged labors having skills, will exert a negative influence on grain production. Lagging in extension of such agricultural technologies as conventional crossbreeding as well as caution in commercialization of GM grain crops will lead to great difficulty in substantial increase of grain yield in a short term. However, for a long term, this approach remains to be discussed. In sum, the conflict between supply and demands of China's grain security is outstanding and the future situation is not optimistic.

3 Fruit production faces the risk of surplus

Fruit industry is the third industry only second to grain and vegetable industries in planting and plays a fundamental position in the national economy. Since 1978, China's fruit industry experienced the household contract responsibility system (1982), fruit circulation system reform (1984), and the seconds round of "vegetable basket project" (1995), which greatly stimulated fruit production in the whole country and the fruit supply capacity realized significant growth. According to statistical data of the Planting Industry Management Department, Ministry of Agriculture, China's orchard area rose from 1.7828 million ha in 1980 to 12.3714 million ha in 2013. The total fruit yield increased from 6.7926 million tons in 1980 to 157.7126 million tons in 2013, as shown in Fig. 1. In the meantime, with economic development and improvement of people's living conditions, fruit demands are also constantly increasing. According to statistics of FAO, the annual per capita fruit consumption grew from 7.30 kg in 1980 to 72.30 kg in 2009, at an annual growth of 8.23%. Domestic fruit processing capacity increased from 0.2802 million t in 1980 to 6.5736 million t in 2009, at annual average growth of 11.49%. The fruit export increased from 0.7579 million t in 1980 to 7.0826 million t in 2009, at annual average growth of 8.01%.



Data source: *China Agriculture Statistical Report* (1998 – 2013)

Fig. 1 Growth of fruit yield and planting area in China

However, due to influence of too high proportion of domestic consumption of fresh fruit, weak processing capacity, low storage level, and unpredictable export trend, China's fruit demands grow behind the fruit production, making China's fruit supply and demand remain in "relatively surplus" and "structural surplus" state for a long time. Especially in recent years, the problem of low price and dull sales occur frequently in fruit industry, which greatly damages benefits of consumers and hinders sustainable and healthy development of fruit industry. Finally, numerous fresh fruits decayed even in the situation of production and sales price inversion. Serious situation of sales of fruits and vegetables has received wide concern. In future, the situation of excess of fruit supply over demand may exist for a long time. According to forecast results of General Office of the Ministry of Agriculture about "*Ensuring Overall Balance and Structural Balance of Major Agricultural Products*" (Fruits), if the fruit planting area expands at the annual growth rate of 1.5%, China's fruit will suffer serious excess of fruit supply over demand by 2020. Therefore, China's fruit production is facing serous risk of excess.

4 Potential threats of China's fruit production to grain security

At the macro level, comparative advantage is theoretical basis for planting distribution and structure adjustment. At the national level, grain production is influenced from per capita farmland area, proportion of non-agricultural income, per unit area grain yield, development of animal husbandry, natural disasters, multiple cropping index, and benefit cost ratio. At the micro level, the comparative income is an essential factor influencing decision of farmers' operation. On the one hand, comparative income of agriculture especially planning is low, leading to high opportunity cost for engaging in agricultural production, particularly in economically developed areas with more non-agricultural employment opportunities. As rational economic entities, if non-agricultural employment provides higher income than land, farmers will naturally abandon agricultural production and select secondary or tertiary industries. This is also an essential reason for wide problem of deserting farmland. On the other hand, farmers owning the planting selection right may select operation items. If comparative income of grain crops is lower than other crops and farmers have skills and experience of planting other crops, changing grain crops to other crops will be a rational selection of farmers. In recent years, China's fruit industry develops rapidly. With constant rising of resident consumption level, in the action of Engels law, the consumption of fruits will further increase, while the consumption of grain will decline. Such trend will not be inversed in a short term. Since operating income of fruit is much higher than grain crops (as listed in Table 1), fruit production posing potential threats to grain security to a certain extent has theoretical basis. In the opinion of FAO, increasing effective grain supply is a precondition for realizing grain security. Grain supply is mainly influenced and restricted by natural resources, economy, society, technology, and system. Farmland and labor resources are most important elements of grain production and play most fundamental constraint role in

effective grain supply[5], and also the focus of conflict between grain crops and fruit production distribution. Therefore, it is necessary to discuss potential threats of fruit production to grain security from the perspective of farmland and labor resources with the aid of theoretical analysis.

Table 1 Comparison of cost – profit ratio between fruits and main agricultural products %

Year	Rice	Wheat	Maize	Soybean	Orange	Tangerine	Apple
2005	39.06	20.37	24.36	30.12	175.71	114.22	119.49
2006	39.05	29.08	35.16	25.36	75.40	81.67	101.87
2007	41.27	28.57	44.66	60.05	107.27	107.27	102.01
2008	35.43	33.00	30.42	51.28	29.10	12.56	86.18
2009	36.77	26.54	31.82	28.43	55.41	74.83	83.54
2010	40.41	21.36	37.89	35.98	75.20	109.06	130.71
2011	41.39	16.56	34.43	24.95	75.97	76.88	110.85
2012	27.08	2.56	21.39	22.25	42.84	70.93	84.86
2013	13.45	-1.4	7.66	5.38	58.60	81.43	66.33

Data source: arranged according to *Compilation of Cost and Benefit Data of Agricultural Products* (2005 – 2013).

4.1 Farmland resources Effective farmland area is the foundation for guaranteeing grain security. In 2006, China clearly stated that we must stick to the red line of 120 million ha farmland area and implement most strict farmland protection system. From then on, the reduction level of farmland area showed slight decline. In 2006 – 2010, the total farmland area remained 121 million ha to 122 million ha. However, there were still different degrees of farmland loss. Only in 2006, the farmland area reduced about 0.306 million ha. In addition, China's agricultural structure adjustment is relatively frequent. In 30 years, it experienced 4 times of large adjustment. The adjustment result is constant reduction in grain crop planting area and increase in vegetable, fruit, fishpond, and garden area[6]. For example, originally, Pearl River Delta and Changjiang River Delta were essential commercial grain production bases in southern China, but due to conversion of farmland to forest land, orchard, and fishpond, as well as non-agricultural land expansion, grain production in both delta areas constantly shrank and they gradually become commercial grain input areas. In recent decade, Guangdong annually purchased about 5 million t of grain from other places, and Zhejiang once the of rice and fishes needs purchasing 2 million t of grain annually. In comparison, the fruit planting area gradually increases from 8.53507 million ha in 1998 to 12.3714 million ha in 2013 and it still increases at present. Such situation reflects, to a certain extent, the competition between fruit and grain with farmland resource, which is consistent with our field survey in southern Jiangxi Province. Since the farmland resources are limited, expansion of cash crops, feed crops, and garden crops will inevitably lead to shrinkage of grain sown area, consequently threaten the grain security. It should be noted that although the accurate replacement proportion of orchards and farmland is difficult to obtain, there indeed exists capital farmland converting to orchards, and the phenomenon is common. Such conversion mainly includes two aspects: first, spontaneous agricultural structure adjustment within the allowable range of policies. Farmers plant fruits in slope farmland, high drainage field, and dry field not suitable for planting grain crops to realize income increase. Second, changing crop varieties in violation of rules and regulations. Some local governments issue various agricultural industry development plans for obtaining better political performance. During the implementation of plans, they force farmers to plant other crops without considering actual situations. In November 2011, for instance, Miqiao Town of Ningxian County in Gansu Province repressed wheat in capital farmland to plant fruits. According to statistics, from 2005, Miqiao Town occupied 400 ha capital farmland in total. In Regulations on the Protection of Capital Farmland, it clearly specifies that "occupation of capital farmland by any unit or individual for the development of forestry industry, fruit industry and digging of ponds for fish farming shall be prohibited". For this provision, local fruit bureau claimed that there is no difference between fruit industry and capital farmland. What's worse, this is not an individual case in local areas. Therefore, with further development of China's fruit industry and further adjustment of agricultural structure, the conflict in land competition between fruit and grain crops will become more intense.

4.2 Labor resources Labor is another essential element of grain production. Any social products including grain are generated from combination of means of production and labor. In the situation of low agricultural production efficiency, small and decentralized operation scale, and low mechanization level, it is extremely necessary to ensure certain number of labors to engage in agricultural production, so as guarantee the grain security. In market economy, farmers are independent economic entities and have full autonomy in management. As rational economic men, they will determine their production and operation items and scale according to acquired information, market prediction and expected income of production and operation items, to pursue maximum profit. For farmers who mainly planting grain crops, their income mainly comes from grain production. When farmers have rights to choose crop planting, crops with higher income will have higher attraction to farmers. Even if local governments encourage farmers to plant grain crops or limit farmers to give up grain production and plant other crops through policies, it is difficult to ensure input of the same amount of labor as grain production for farmers

planting several crops at the same time. In the later period of the 1990s, the grain supply exceeded demands and grain price declined, production income was not high; as a result, grain production elements including labor flow to non – grain crop production, and grain yield dropped annually, consequently influencing the grain security[7]. Take Ganzhou City of Jiangxi Province as an example, about 800000 farmers were engaged in fruit production in 2011, increasing about 200000 farmers compared with 2000. In comparison, the number of people engaged in primary industry reduced from 2.285 million to 1.913 million in the same period. Considering the fact of numerous rural labors flowing to secondary and tertiary industries, sharp increase in fruit farmers in Ganzhou City may be explained using internal structural transfer of industries. Besides, different from grain crops, fruit industry is a labor intensive industry and it needs numerous workers for every link in the industry chain from orchard fields to hands of consumers. The logistics, warehousing, and processing have much higher capacity of absorbing rural labors than fruit planting itself. According to our survey, in 2011, about 600000 fruit farmers were engaged in the navel orange industry in Ganzhou City, but the whole industry involved about 850000 workers. Some rural labors engaged in fruit related industries may not completely separate from farmland or still keep original scale of grain production, but due to restriction of limited labor, the work input to grain production will inevitably decrease, which indirectly form the competition of labors between fruits and grain crops.

5 Fruit production distribution and adjustment strategies under the constraint of grain security

The *Twelfth Five – Year Plan of the National Planting Development* (2011 – 2015) issued by Planting Industry Management Department, Ministry of Agriculture in 2011 stated that it is required to take optimizing regional distribution as basic requirement of planting development. The purpose is to determine major points of regional agricultural development, adjust regional functional orientation, bring into play resource advantages, optimize distribution of grain crops, cotton, oil, sugar, fruit and vegetable, guide concentration of processing, circulation, warehousing and transportation facility construction to superior production areas, through accelerating implementation of regional distribution plan for agricultural products, to establish industrial belts with outstanding advantages and characteristics, convert regional resource advantages to product, industry and economy advantages, strengthen effective supply and market competitive power of agricultural products, and improve overall quality and benefits of the planting industry[8]. Nevertheless, such plan is based on macro environment of planting industry, thus it has certain limitations to distribution adjustment of fruit production. In this situation, it is recommended to actively seek suitable adjustment strategies for national fruit production distribution under the constraint of grain security from the fruit production distribution itself.

5.1 Stabilizing existing fruit planting area to satisfy increasing demands with the aid of scientific and technological progress

It is required to stabilize existing fruit planting area. According to present level of fruit demands, most experts believe that it is suitable to keep orchard area in the range of 10 million ha to 12 million ha. All areas should put farmers' benefits in the first place, orient towards market, make scientific fruit industry development plan, and intensively use labors and means of production in existing orchard management, instead of blindly expand the low level production scale. Besides, it is recommended to satisfy increasing fruit demands with the aid of scientific and technological progress. Future fruit development should focus on transformation from scale expansion to increasing per unit area yield and improving quality and benefits. (i) Enhancing fundamental researches and science and technology reserve for fruit. Especially, it is recommended to place scientific and technological innovation in fine seed breeding, consolidate seedling resources, increase research and development input, conduct deep cooperation, and establish government guiding, department coordinating, colleges and universities participating pattern. (ii) Innovating upon systems and mechanisms. It is recommended to encourage cooperation of industrial technical system, large farmer households, farmers' specialized cooperatives, and leading enterprises, explore new channels for conversion of scientific and technological achievements, new paths for large scale production, new modes for socialized services, and new approaches for industrialized operation. (iii) Energetically popularizing simple cultivation, high quality and high yield cultivation of fruit crops, commercialized treatment, storage and fresh keeping technologies, promoting large scale planting, standardized production, commercialized treatment, brand sales, industrialized operation, and establish and improve standard orchard quality and safety inspection and tracing mechanism, to improve fruit quality, production organizational level and industrialized operation level. In sum, it is recommended to satisfy increasing fruit demands through scientific and technological progress, with the aid of increasing per unit area yield, enhancing processing capacity, improving circulation efficiency, and optimizing structure on the basis of expanding existing fruit planting area.

5.2 Guiding fruits to transfer to advantageous and ecological suitable areas to provide sufficient space for grain production

For a long time, the fruit industry should take the Scientific Outlook on Development as guidance, adjust structure and distribution of fruit industry, transform development modes, guide production elements to centralize in advantageous production areas, develop intensive operation, and improve industry quality and market competitiveness. It is recommended to further optimize regional distribution of fruit production, guide fruit to transfer to advantageous regions and ecological suitable areas, and make effort to release land and labor resources through reasonable distribution, large-scale operation and vertical planting and breeding on the basis of strict protection of farmland. (i) Sticking to the principle of not competing land with grain production. Advantageous

regions should scientifically plan and strictly control new orchard development in accordance with ecological, climatic, soil, slope and water conditions, actively use slope farmland, high drainage field, and dry land to develop fruit industry, resolutely eliminate fruit planting in unsuitable areas, adjust and reduce planting in non-advantageous regions, and exit fruit planting in capital farmland, to provide sufficient place for grain production. (ii) Actively developing intercropping of fruit trees with grain crops and cash crops, and conducting vertical orchard planting. Suitable areas should develop vertical agriculture, full explore and use various resources, and increase agricultural resource utilization efficiency, land output rate, to realize harmonious coexistence of fruits with other crops. (iii) Promoting optimization of fruit tree structure. Under the condition of total fruit planting area not changed, it is recommended to properly reduce planting area of staple fruits, adjust planting area of apple, orange and pear to 50%, expand planting area of pineapple, mango, litchi, and longan, to satisfy diversified demands of consumers for fruits. (iv) Encouraging local skillful fruit farmers, leading enterprises and cooperatives to contract orchards, implement relatively centralized large scale production, specialized operation, and market-oriented operation. It is recommended to strengthen socialized services for process before the production, in the production and after the production, improve organizational level of fruit production, and actively popularize and develop mechanized operation in suitable regions, to reduce worker demands of orchard production.

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