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## The Research Review about the effect of bio-fuel development on agricultural market and agriculture

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### Abstract

The development of bio-fuel has attracted great attention from various countries, for it can solve the global energy crisis to some extent. However, due to the raw materials of bio-fuel are mainly maize, sugar cane and other crops, the development of bio-fuel industry will inevitably affect food security. This paper observes present studies on the effect of the development of bio-fuel from four aspects, that is, agricultural market, agricultural inputs, agricultural development and family welfare to make some basic work for China's relevant research and provide reference for the introduction of China's relevant policies.

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The development of bio-energy as a renewable energy has been driven strongly by market-demand and national government support and becomes the fastest among alternative energy. Due to technical and economic feasibility, the main development direction of bio-energy concentrates on the development of liquid bio-fuel (called "bio-fuel" for short below). The development of bio-fuel saves resources for many countries and has brought great opportunities to the country's economic growth. Because raw material for bio-fuel are mainly grain and oil crops, its development will bring a certain extent of effect on food security.

With the development of bio-fuel, global grain price is rising today, whose effect on food security has become increasingly prominent. This situation has caused extensive attention among many countries. Many foreign scholars and experts have made a lot of research work on this area. This paper observes relevant studies about the impact of the development of bio-fuel on markets for agricultural products, agricultural inputs, agricultural development and family welfare to make some basic work for China's current research and provide a reference for the introduction of China's relevant policies.

## 1. The impact of bio-fuel's development on markets for agricultural products

The share of bio-fuel in the entire energy market is relatively small, but its development has the great impact on agricultural products market. In general, the impact of bio-fuel development on the agricultural market are shown in the following two aspects: First, affect the production and consumption structure of agricultural products; Second, affect the price of agricultural products.

### 1.1 The impact of bio-fuel development on the production and consumption structure of agricultural products

The development of bio-fuel has direct effect on the production and consumption structure of agricultural products. Birur, Hertel and Tyner<sup>[1]</sup>(2007) said that if we want to achieve the objectives and the rules the European Union and the United States use compulsorily, the materials onshore used for producing bio-fuel such as grain, rapeseed, sugar cane and other agricultural products would have a substantial increase in demand and more land would be used for cultivation of these crops, which promotes the change of agricultural production structure. They estimated that coarse grains production area will increase by 11% or 12% by 2010 in Canada and the United States, and rapeseed production area will also increase by 12% or 21% in Brazil, Canada and the EU. Banse and others<sup>[2]</sup>(2008) also predicted that the coarse grains and sugar cane planting area would have a substantial increase (especially in Africa and Latin America) caused by the mandatory bio-fuel policy mix and as a result, reduced the planting area of other crops and changed agricultural production structure.

Other research analyzed the impact of bio-fuel development on the consumption structure of agricultural products. K.Cassman et al.<sup>[3]</sup>(2006) pointed out that the energy industry's (ethanol) expansion will consume more corn. He found that 19.6% of corn were used for ethanol production in 06-07, and the rate be expected to rise to rise to 29.6% in 2010, 2011 according to the U.S. data. He considered that the industry will continue to expand, because ethanol producing has a larger profit margin in the current prices of gasoline, ethanol and corn. Xin'an Deng<sup>[4]</sup>(2008) first proposed the concept of energy agriculture, it was defined as the agriculture for the purpose of producing biomass energy. The development of bio-fuel industry absorbed agricultural products for the production of alternative energy which led to the change of consumption structure of agricultural products. Chao-min LI, Fang Liu<sup>[5]</sup>(2008) pointed out that the U.S. build a large number of ethanol company which had caused the change of the structure of grain consumption, and thus had a significant effect on the food supply in the world market and led to the change of price system and import and export regional structure.

### 1.2 The impact of bio-fuel development on the price of agricultural products

Bio-fuel development had an impact on the price of agricultural products in a certain extent, but scholars' points on the extent of this impact are not consistent. D.Mitchell<sup>[6]</sup>(2008) submitted a report recently indicating that for the rapid expansion of the biofuels industry in United States and the European Union, the stocks of global wheat and rice had dropped significantly, while price of grain products had also greatly increased. According to the statistics, 65% prices increasing of grain products was caused by due to the rapid growth of bio-fuels in the demand for bio-fuel and feedstock crops. IFPRI<sup>[7]</sup>(2008) released a report also showing that the expansion of biofuels as an alternative energy to deal with rising oil prices, not only became a major factor in rising food prices, but also had a profound impact on the world food situation.

Different from the results of the above study, Tjasa Bole and Marc Londo<sup>[8]</sup>(2008) considered that the impact of the global bio-fuel development on global food price is relatively small currently. They used a bottom-up analysis method which considered the change of grain prices in the market and the more realistic impact of these changes on bio-fuel production. They used the relative cost of production and Break-Even Point to assure that the amount of bio-fuel can be estimated, and then showed the bio-fuel demand for agricultural products is not in a unlimited growth trend coupled with the cyclical nature of the market so that they think that bio-fuel in the long term will not cause excessive increase in the price of agricultural products. In addition, the study also found that agricultural products and other raw material cost is lower in the current food prices. Usually grain cost account for about 10% in the retail price of food in developed countries. Thus they believe that at present the increasing price in the international agricultural products market is affected by the elasticity of food consumption and the retail cost in a

very large extent . The International Federation of Agricultural Producers (IFAP), said the land for biofuel production accounts for a very small proportion of agricultural land in the world (Brazil 1%, Europe 1%, United States 4%), bio-fuel production is only a marginal factor in rising food price, and has little impact on the increase of real price.

Dawe<sup>[9]</sup>(2008) research on the conduction of international price on domestic price showing that the development of bio-fuel will not have great impact on food price. He selected seven major Asian rice-consuming countries as the object of study, and calculated the average price of rice and found that only one third of the international market price was transferred to the domestic market. Gunjal<sup>[10]</sup>(2008) also got the same conclusion with the above research, but he preferred the data that the price of white maize in South Africa from 2007 to 2008, and analyses showed that in the U.S. corn price is rising due to strong demand for bio-fuel constantly increases, but at the same time, domestic price had remained stable. In addition, FAO(2008a) also supported the view, studies had shown that food price was also subject to their exchange rate, the higher international food price have not been fully reflected in the domestic price.

Some scholars also study the impact mechanism of the bio-fuel development on agricultural products price. Schmidhuber<sup>[11]</sup>(2006) considered that the rise in energy price and bio-fuel technologies gradually mature resulted in energy demand for agricultural products, thus the energy price with the price of agricultural products became synchronical. Rosamond L. Naylor<sup>[12]</sup>(2007) 's studies have shown that the expansion of bio-fuel production have both direct and indirect effects on agricultural products price. Bio-fuel increased demand for corn, as a result , led not only to increase in the price of corn itself, while also cause expansion of short-term corn planting area ,and then squeeze other crops planting area , the international market prices of agricultural products generally rose. In addition, A. Elobeid et al.<sup>[13]</sup>(2006) studied the effect of ethanol fuel production based on corn on grain, oil plants and other agricultural price, but did not draw quantitative conclusions. He considered several key decisive factors in the study, including crude oil price, the price of DDG by-product, plant fixed costs, the use of land protection, corn and oil crops production, as well as public policy, and assumed that the ethanol producers would stop the production of corn ethanol in the case of marginal revenue at zero. They also analysed the development conditions of bio-fuel currently using the relevant theory of the economics. P. Conforti.<sup>[14]</sup>(2004) study the transmission mechanism of international price increases, and showed that the development of bio-fuel did have a certain transmission role in agricultural products price. He selected a more representative sample of 16 countries, and did empirical test on the FAO's database which collected daily food commodity prices (the database collected price including export price, wholesale and retail price). The results showed that the grain market price in African countries among the sample were not the same with Asia and Latin America experienced complete transmission of international price.

## **2. The impact of bio-fuel development on agricultural development**

In recent years, bio-fuel development had some effect on the rising price of agricultural products, although this effect was not inconclusive at present, but the rising price caused by the bio-fuel development indeed had impact on of farmers' income, employment, family welfare and agricultural development.

### **2.1 The impact of the bio-fuel development on farmers' income and family welfare**

Most scholars focus on the analysis of one country's food , energy production and consumption in the study of the impact of bio-fuel development on a country's food security. Tyner WE and Taheripour F<sup>[15]</sup>(2008) showed that if the rise in food price can be largely transferred to energy exports for the low grain-producing country, the country's overall food consumption will not be greatly affected. However, according to FAO's 2005 statistics, there were 82 low-income countries in the world which were not only net importer of food but also energy net importer. The rising grain price in international market would lead to pay a huge cost of import for the food consumption for a country. Therefore, the rising grain price would cause serious impact on a country's welfare. C. Ford Runge<sup>[16]</sup>(2007) found that even Mexico was also affected which was oil exporter and food importer. 80% of yellow maize in Mexico came from import, but due to the rised international market price of yellow maize, the domestic food manufacturers tended to use domestic sweet corn, therefore, the domestic price of sweet corn rose sharply. Such as in sub-Saharan Africa many families are landless laborers, and 50% to 80% of these labors' income was used in daily food expenses. Therefore, the rising price would be a significant impact on their welfare. Studies had

shown that the real price of the world's major food crop rised at the rate of 1%, the number of global hunger people would increase 16 million. According to estimation, by 2025 the number of hungry people around the world would reach 120 million.

Other scholars research the impact of the rised food price on food security from the family level and think that the impact of the rised grain price on the family depends largely on the family's market position in staple food in the short term, that is, the family is a net buyer or a net seller in the agro-food market. Aksoy and Isik-Dikmelik<sup>[17]</sup> (2008) conducted a study from the perspective of a net seller, and they selected three main food as research object, computed the proportion of net sellers in the developing countries among the sample. The record showed that the proportion of the net sellers family differed from 7% to 51% in the sample countries. While the proportion in rural areas range from 12% to 59%. Calculate the average value of all countries without ing weighted, only 23% of the common family and 31% of rural households were net food sellers. This indicated that most households in the sample were major net buyers of food, and agricultural commodities price increase would not improve overall welfare in the family level. Barrett<sup>[18]</sup> (2008) thought that the majority of farmers or rural households did not belong to the ranks of net food sellers in sub-Saharan African countries, food price increase did not increase income of peasants. In their view, if the economic feasibility of using cassava to produce ethanol achieved commercial standards, cassava price increase could only give a big landowners much more income, and to those landless workers, the general rise in food price only take them fewer intake of calories, which make it difficult to get rid of the long-term malnutrition situation. FAO(2008a)study also showed that in the rural areas where agriculture and food production as the mainstay, the proportion of poor small-scale operators who at the same time were net sellers is not more than 37%, four of seven countries' proportion was even 13% or lower, food prices increased did not play a positive role in farmers' income increase.

Compared to the above research, rural income-generating activities<sup>[19]</sup>(RIGA) project researched from the perspective of the farmer's family status,that is, farmer was a net buyer or net seller. On the one hand, it introduced a compensatory variable to quantify the impact of the price increases 10% on family welfare, and divided the family taking quinquesection method and estimated the relative impact of price change. The study found that in both rural and urban areas, net buyers among the most poor people(the bottom 20% of the poverty population) suffered the biggest brunt of price rise.They would suffer 2.7% net losses if price increased 10%. while the one-fifth of the poorest people face a net loss of approximately 2.0%. On the other hand, they investigated "specialized households" as a net producer of agriculture ,take the example of Bangladesh and Vietnam. It was found that agricultural products price increase in Bangladesh increased the welfare of agriculture specialized households by an average of 1.7%, (the welfare of 20% of the poorest the population increased by 1.3%, (the welfare of 20% of the most affluent the population increased by 1.8%). In Vietnam, rich specialized households was the largest group of getting benefit, their well-being increased by 2.2-2.3%. Moreover, this project has also made the appropriate improvement on research method, in the analysis, they did not consider the adjustment of any other household production and consumption patterns, that is, without regarding to labor market price, long-term supply adjustment, and the market price of other elements to analyze the impact of rising food price on social welfare. Taylor<sup>[20]</sup> (2006) also analysis ed from the two perspective, he selected four countries in Central America, simulated the possible impact of food prices increase 10% in a general equilibrium framework. The results showed that, all residents including agriculture specialized households, would be subjected to more than 2% of the welfare losses. In addition, Ivanic and Martin<sup>[21]</sup> (2008) quantified unit income and expenditure of family household using the expenditure and revenue functions, and simulated a variety of food products' prices increased 10% based on the envelope theorem to analyze the percentage change of one dollar poverty rate every day. The conclusions were very similar to Taylor's.

## 2.2 The impact of Bio-fuel development on the employment of the farmers

Bio-fuel development not only has an impact on the income and welfare of the farmers, but also bring new opportunities to country's economic development, such as increasing employment. Von Braun's<sup>[22]</sup> (2006) found that the development of bio-fuel can contribute to increase the planting amount of cash crops, and the impact of planting cash crops on the employment for poor families were very significant. Statistics showed that 30% of sugar cane in Brazil were produced by 60000 farmers independently, the peasants without land can be engaged in the processing of raw materials, transportation and other labor-intensive work in the process of bio-fuel production. According to the current development of bio-fuel, he also pointed out that many developing countries have mastered the bio-fuel

technologies, and would build ethanol plants in remote areas, the construction and operation of these plants could provide more jobs and economic vitality for remote areas. Moreira's<sup>[23]</sup>(2006) study pointed out that Brazil's bio-fuel industry provided about one million employment in 2001, basically in the rural areas, and most are low-skilled jobs, 65% of which belonged to long-term employment, 35% short-season work.

### 2.3 The impact of bio-fuel development on economic development of agriculture

Raw material costs accounts for 70% to 80% of the cost of bio-fuel, means that agricultural products are the main input factor of bio-fuel production. Therefore, increasing demand for agricultural productions caused by the development of bio-fuel plays a good role in promoting economic development of rural areas. To some extent, its effect of promoting agriculture even beyonds processing industries and service industries. World Bank's(2007) econometric analysis on contribution rate of national GDP growth showed that, taking into account the scale of agriculture, the efficiency of poverty reduction brought by agricultural GDP growth was at least twice than other areas. Bravo-Ortega and Lederman<sup>[24]</sup>(2005) found that not only agriculture made the greatest contribution to poverty alleviation, but also the growth of primary industry had a significant impact on living standard of the poor. Moreover, Timmer<sup>[25]</sup>(2002) considered that the amount of contribution of agricultural growth to poverty reduction depended on the level of inequality in a country and the proportion of agriculture in the economy and employment.

### 3. The impact of bio-fuel development on food security of developing countries

Bio-fuel as a substitute for fossil fuels is more attractive for the upsurge of oil price, support of government to the production of ethanol and biodiesel and other bio-fuel. the global ethanol production had doubled and reached 620 billion liters for the year 2000-2007 (OECD - FAO database); In the same period, the production of biodiesel increased by more than 10-fold reaching more than 170 million liters. The development of bio-fuel, to some certain extent, ease the energy crisis, but the specialties of bio-fuel sources (mainly got from processing sugar cane, corn, soybeans and other crop) changed the use of crops in traditional agriculture. Previous crops just were used as food and feed grains, while feed grains gave service to people's diet. Now, the production of bio-fuel uses a part of crops, so more and more scholars begin to worry about the phenomenon of "fight for food with people".

Senauer and Sur<sup>[26]</sup>(2001) predicted that the number of global undernourished people would increase to 440 million if the relative base of grain price rised by 20% in 2025 (of which 195 million in sub-Saharan Africa, 158 million in South Asia and East Asia). According to the International Food Policy Research Institute (IFPRI) estimated, under the existing national bio-fuel development plans, the expansion of bio-fuel would make corn, oilseeds, cassava and wheat price rise by 26%, 18%, 11% and 8%, resulting in reducing calorie intake per capita range from 2% to 5% and the increasing child malnutrition rates at the average rate of 4% (Msangi<sup>[27]</sup>2008). Block<sup>[28]</sup>(2004) which had the similar view with the above view showed that in the case of the rising of rice price in Indonesia in the late 1990s, the mothers of poor households reduced their food intake to meet the child's nutritional needs, thus so that caused a serious shortage of hemoglobin. From these studies we can see that the direct net effect of the increase of food rice caused by the development of bio-fuel on food security may be negative .

### 4. conclusion

To sum up, on the one hand ,most scholars place more emphasis on the research of the effect and its effect mechanism of the development of bio-fuel on the global grain price; on the other hand, some scholars study on the hunger and food insecurity caused by general rise of agricultural products' price and consider bio-fuel industry has indeed caused a substantial increase of global agricultural products' price so that give challenges to food security of the poor. In a word, the development of bio-fuel had wide-ranging effect on agricultural production, consumption structure and agricultural products' price and farmers' employment, income, welfare, agricultural development even food security.

The development of bio-fuel is an important issue on economic development of agriculture. Studying the impact of bio-fuel on food security will provide important guidance and reference for establishing policies on the development of bio-fuel industry, which is particularly important for our country with the scarcity of land and energy. We must do the following work to develop bio-fuel and ensure food security: First, perfecting government

governance and guide, develop bio-fuel industry on the premise of ensuring basic amount of food consumption. Second, we should focus on how to increase the benefit of the poor in developing bio-fuel industry. Third, we should increase technological investment and make full use of marginal land and non-food crops to serve the production of bio-fuel.

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