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A Study on the International Trade Issues of China's Land-intensive Agricultural Products

^{1,2}Tianbao Guo, ²Ying Nie and ¹Yunfeng Wang

¹College of International Economics and Trade, Jilin University of Finance and Economics, Changchun, Jilin, 130117, China

²School of Economics and Management, Jilin Agricultural University, Changchun, Jilin, 130118, China

Abstract: The implementation of the virtual land strategy, it can not only ease the pressure of cultivated land resources and protect the ecological environment but also make use of the comparative advantage in our country, adjust the grain planting structure which has the vital significance. This study selects the Chinese foreign trade volumes of 4 kinds of main foodstuff, wheat, soybean, rice and corn, with their virtual cultivated land trade from 1978-2010 and analyze on their contributions to the cultivated land resources in china. The results show that the foreign trade in main food crops on the virtual land has maintained a large trade deficit, except for a few years, most of statistics show a net import state; it is not synchronous between the economy effect brought by China's foreign trade in cultivated land resources and the foreign trade balance in grain trade.

Key words: Virtual cultivated land, grain trade, empirical analysis

INTRODUCTION

With the accelerating development of the urbanization and industrialization, the downward trend of cultivated land resources in China appears. The cultivated land resources supply and demand contradiction in China is increasingly outstanding, the increase in population and the unceasing growth in people's living standards have put forward higher requirements on food supply and also put forward higher requirements on food production and the necessary land supply. It is a new way to alleviate the contradiction through the implementation of the import strategy of grain in virtual land resources (Otsuki *et al.*, 2001).

The traditional way to study grain trade problem is from configuration of land resources and cultivated land resources. And it is a new way to study the hidden flow in "virtual land" of the grain trade which will broaden allocation view on the cultivated land resource management and land resource and it makes the implementation of the virtual land strategy another efficient tool for cultivated land and food security (Moenius, 2004).

At present, there are few international researches on virtual cultivated land resources and most are inspired by the study of virtual water resources. The domestic scholars such as Luo Zhenli, with the help of the virtual water concept, firstly proposed the concept of "virtual earth" and "virtual land strategy". After that, the domestic

scholars have conducted the related research to the virtual earth and virtual cultivated land and the studies mainly focus on the following 2 aspects: One is the research on strategic significance on the implementation of the virtual earth or virtual cultivated land; another is the accounting research on the trade volume of virtual land or virtual cultivated land. With the rapid development of China's grain trade, the calculation method of trade volume of hidden virtual resources and its contribution to China's agricultural resources along with the discussion and analysis of the above problems have the important practical significance in achieving food security, promoting the sustainable development of agricultural resources and social economy in China (Chapagain and Hoekstra, 2003).

In this study, through the calculating of the trade volume of grain trade on the virtual land from 1978 to 2010 in China and the analyzing on the positive contributions of the virtual land trade to ease the pressure of cultivated land resources in China, we can ensure food security and achieve sustainable use of resources and explore the issues related to implementation of the virtual land strategies.

CONCEPTS AND RESEARCH METHODS TO VIRTUAL CULTIVATED LAND

The concept of virtual cultivated land source and virtual land strategy derives from the virtual water.

“Virtual water” initially advanced by the British scholar Tony Allan in 1993, it referred to the quantity of water resources consumed in the production of commodities and services, also known as “embedded water” or “external water”. Virtual water is “invisible” water, being stored by the invisible way in the physical form of commodity. The agricultural products trade between countries and regions is based on the form of import or export of virtual water resources to some degree (Wichelns, 2003).

The virtual land refers to the required amount of cultivated land resources in the production of certain goods or services. The virtual land strategy is that in the country or region being short of cultivated land can trade with the countries or areas with rich resource of cultivated land to buy intensive land resource products (mainly food products) to obtain the cultivated land and food security. In fact the country or the area with the products export of intensive cultivated land resource is to export the virtual cultivated land resource. Being similar to the study on the virtual water trade, virtual cultivated land trade study is attempt to use a product accounts to explain the way of the effective configuration of cultivated land resources in the global economic system. According to the existing studies, there are two kinds of calculation methods of virtual cultivated land trade volume: the first is from the perspective of generator on the virtual cultivated land and it is defined as the amount of cultivated land resources actually used in the production place of producing the products, mainly taking the factors of natural and geographical conditions, the main crop growth in production technology and management methods into consideration, reasonable optimization of the calculation results can effectively guide the local land management departments to do a better job in cultivated land resources; the second is from the consumer's point of view and it is defined as the cultivated land quantity needed in the consumer place to produce the homogeneous products, this calculation using the consumption place as a benchmark has a direct reflection of the amount of cultivated land resources saved by the implementation of the import substitution strategy, the results can be used to implement the import substitution strategy on what kind of products (Yang *et al.*, 2003; Hoekstra and Hung, 2005).

When calculating the export volume of the food trade on virtual land, the research is quantified from the point view of generator; when calculating the imported food trade, the research is quantified from the consumer's point of view; and all researches are from the import and export perspective of food trade impacting on China's cultivated land resources. The trade volume of virtual cultivated land

depends on the import and export trade volume and the amount of the product yield per unit, the calculation formula is as follows:

$$NVLI_t = \sum_{i=1}^n \frac{CI_{i,t} - CE_{i,t}}{AP_{i,t}} \quad (1)$$

In the equation: NVLI_t shows in t year the net imports of food crops trade on virtual cultivated land (h m²), CI_{i,t}, CE_{i,t}, respectively stands for the amount of I food crop imports and exports in year t (T), AP_{i,t} stands for the yield per unit of I crop in year t (t hm⁻²).

TRADE SITUATION ON VIRTUAL LAND RESOURCES IN CHINA

China uses less than 7% of the world's arable land to feed nearly 20% of the world population, however, China's population is still increasing, the potential soil and water resources are limited and often squeezed by other industries, the food security has become one of the most important concerns for the Chinese government. China is a large country of grain production and an important member of grain trade in the world. With the development of grain foreign trade, making full use of two markets-domestic one and foreign one and two kinds of resources, we can associate the national food security with long-term goals of promoting the adjustment of agricultural structure, increasing agricultural efficiency and international competitiveness, implementing the strategy of sustainable development; thus it further enhances the layout optimization of grain production in China and the level of food safety in China (Kumar and Singh, 2005).

As can be seen from Fig. 1, from the year 1978-2010, China was the major net food importing country, the cumulative net imports reached 378000000 tons, in 23 years being net food importing country, only 9 years being the net exports country and in 2009, the net imports were 48950000 tons, the highest net imports was in 2010, 64200000 tons; in 1993 the net exports got a highest quantity, 6220000 tons.

The foreign trade of grain in China mainly focuses on these four products: Rice, corn, wheat and soybean. From 1978-2010, imports of these four kinds of food products accounted for 93% of the total grain imports and the exports accounted for 91%. Among them, wheat and soybeans are China's major import varieties; rice and corn are the main export varieties. From single grain varieties, from 1978-2010, China's total wheat net imports is for 208853000 tons, the annual net imports is for 9080000 tons; China's soybean import and export can be

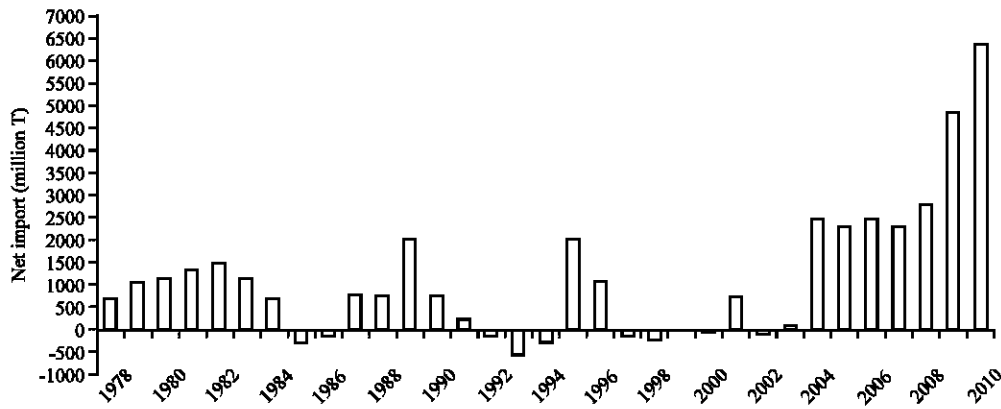


Fig. 1: Changes of net import of grain trade in China from 1978-2010

Table 1: Changes of net imports of main agricultural products in China from 1978-2010 (10,000 tons)

Year	Grain	Rice	Corn	Wheat	Soybean	Year	Grain	Rice	Corn	Wheat	Soybean
1978	695	-	-	767.0	-	1996	1052	49.7	209.0	773.4	92.1
1979	1071	-105.3	-	871.0	-	1997	-148	-59.3	-666.8	146.4	269.8
1980	1181	-111.6	-	1097.0	-10.0	1998	-198	-349.6	-444.0	1273.0	302.9
1981	1355	-	54.0	1307.0	-14.0	1999	13	-256.2	-425.4	34.1	411.3
1982	1487	-45.7	150.0	1353.0	212.0	2000	-44	-271.3	-1047.6	73.1	1020.4
1983	1148	-56.6	205.0	1102.0	-35.0	2001	835	-157.7	-596.1	2.6	1367.8
1984	688	-118.9	-89.0	1000.0	-84.0	2002	-97	-175.2	-1166.7	-34.5	1101.0
1985	-332	-101.9	-625.0	541.0	-113.9	2003	53	-235.8	-1639.0	-206.7	2044.6
1987	-169	-95.6	-505.0	611.0	-107.9	2004	2484	-14.3	-2232.0	616.9	1988.1
1988	816	-39.5	-380.0	1455.0	-132.8	2005	2227	-16.4	863.8	2933.0	2617.8
1989	1002	-32.0	-343.4	1488.0	-116.9	2006	2463	-52.3	-303.4	-89.7	2787.5
1990	789	-27.1	-303.5	1253.0	-939.0	2007	3453	-85.0	492.0	10.0	3036.0
1991	259	-54.7	-778.1	1237.0	-110.9	2008	3684	-44.0	27.0	4.0	3687.0
1992	-189	-94.0	-1034.0	1058.0	-539.0	2009	4279	-43.0	13.0	90.0	4219.0
1993	-622	-134.5	-1109.9	615.9	-27.4	2010	5577	-23.0	13.0	123.0	5464.0
1994	-263	-102.7	-874.7	706.0	-78.1	??	37407	-2790.0	-12175.0	20885.3	29310.3
1995	1967	158.8	514.9	11402.0	-7.8						

Statistical yearbook of China

divided into two stages: From 1978-1995 the net export stage, running into the net import stage in 1996 and net imports and even getting a high record, reached 54640000 tons in 2010. For many years China's rice, corn trade is the net export state. Since 1978, China's total net exports of rice trade amounted to 27900000 tons; the highest annual net exports amounted to 3496000 tons. Corn is one of the Chinese traditional export food varieties in foreign trade, from 1978 to 2010 cumulative net exports amounted for 121750000 tons. Generally speaking, in China's foreign grain trade, the net imports of soybean shows an increasing trend; rice, corn are mainly net exporting, wheat has shown the trend of net exports (Table 1).

According to the Eq. 1 and the above data we can get to know China's grain imports on virtual land resource from 1978-2010 (Table 2). It is shown in Table 2 as the imports of China's four major grain varieties in the virtual land resource from 1978-2010. In 33 years from 1978-2010, the imports of grain trade on virtual land in

China increased from 4157200 hectares in 1978-31908000 hectares in 2010, being an increase of nearly 700%. The imports on virtual land showed a year-on-year growth trend but with a big fluctuation, it can be mainly divided into four period: The first period is from 1978-1985, during this period, because of the fluctuation of wheat imports on virtual land, the import volume increased from 4157200 hectares in 1978-6259900 hectares in 1981 and in 1985-101.4 million hectares; for the second period is from 1986-1993, on this stage, mainly because of the same wheat import fluctuation, the import volume on virtual land increased year by year from 1986, until 1989 reaching 3000900 hectares and later in 1993-98.36 million hectares; during the third period from 1994-1997, the wheat imports changed from a substantial increase into a rapid decreased, except for year 1995 which rose to 11400000 tons, corn import also got the highest import in history, reaching 5149000 tons, with the fluctuation of wheat and corn import, the virtual land imports began to increase to 4595800 hectares from 1944-1995, then later

Table 2: Movements of grain trade on the virtual cultivated land in China from 1978-2010 (10,000 ha)

Year	Rice on virtual cultivated land		Corn on virtual cultivated land		Wheat on virtual cultivated land		Soybean on virtual cultivated land		Sum up		Net import
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	
1978	-	-	-	-	415.72	-	-	-	415.72	-	415.72
1979	-	3.44	-	-	407.58	-	-	-	407.58	35.44	372.14
1980	-	38.60	-	-	580.73	-	-	9.10	580.73	47.70	533.03
1981	-	-	22.31	4.59	620.31	-	-	12.04	642.62	16.63	625.99
1982	-	13.36	48.04	2.14	552.47	-	33.74	13.98	634.25	29.48	604.77
1983	-	15.87	58.22	1.66	393.29	-	-	27.13	451.51	44.65	406.86
1984	-	31.61	1.52	23.99	336.81	-	-	63.11	338.33	118.71	219.62
1985	-	28.56	2.50	175.77	184.20	-	0.07	83.82	186.77	288.15	-101.38
1986	-	25.58	15.92	152.23	200.99	-	20.79	97.86	237.70	275.67	-37.97
1987	-	26.10	39.29	100.00	442.51	-	18.48	115.78	500.28	241.88	258.40
1988	8.38	19.05	2.80	99.54	490.23	-	10.59	103.14	512.00	221.73	290.27
1989	-	8.30	1.75	90.30	288.99	-	0.08	92.13	490.82	190.73	300.09
1990	1.47	8.23	8.16	75.24	392.30	-	0.07	64.60	402.00	148.08	253.91
1991	3.62	17.48	0.02	169.99	399.03	-	0.07	80.49	402.75	267.96	134.79
1992	0.25	23.39	-	228.11	317.62	-	8.49	46.29	326.35	297.78	28.58
1993	2.37	35.19	0.02	223.66	183.29	8.27	6.11	23.04	191.79	290.15	-98.36
1994	12.59	37.75	0.04	186.43	219.89	7.82	3.00	48.01	239.53	280.01	-50.49
1995	39.00	1.35	107.06	2.34	328.26	6.35	17.94	22.64	492.26	32.68	459.59
1996	17.80	6.37	8.59	4.57	222.25	15.13	62.94	10.90	311.58	36.98	274.60
1997	8.12	21.52	0.07	152.06	46.86	11.17	163.51	10.65	218.55	195.40	23.15
1998	5.83	84.29	4.78	89.07	42.01	7.46	179.53	9.65	232.16	190.46	41.69
1999	4.30	61.17	1.60	87.62	12.79	4.16	241.48	11.57	260.17	164.52	95.65
2000	5.67	67.47	0.07	227.90	24.59	5.03	629.17	12.98	659.49	313.38	346.11
2001	6.79	43.35	0.83	127.69	19.42	18.73	857.85	16.12	884.88	205.89	678.99
2002	5.49	45.93	0.16	237.06	16.76	25.87	597.73	16.11	620.12	324.97	295.15
2003	6.10	61.68	0.02	340.56	11.37	63.94	1254.75	17.85	1272.24	484.02	788.22
2004	17.34	20.58	0.04	45.39	170.70	25.61	1114.60	19.23	1302.68	110.81	1191.80
2005	11.91	15.65	0.08	163.49	82.76	14.15	1559.59	24.22	1654.34	217.49	1436.85
2006	16.73	28.72	1.21	57.45	13.47	33.19	1642.65	22.95	1674.06	142.31	1531.75
2007	76.17	20.73	-	52.20	21.70	21.40	2105.91	31.49	2204.31	126.22	2078.09
2008	50.28	14.78	-	48.60	8.40	38.01	2220.64	27.88	2279.32	129.27	2150.06
2009	54.67	12.00	-	24.72	19.00	27.85	2633.05	21.66	2706.72	74.73	2632.49
2010	59.52	9.46	-	22.87	26.00	25.27	3258.03	95.13	3343.55	152.73	3190.82

coming to a sharp decrease to 231500 hectares in 1997; the fourth period is from 1998-2010, during this period, there was a rapid increase in soybeans imports, the imports volume increased from 3029000 tons to 54640000 tons (with a growth of 1800%), although wheat imports decreased (average annual import volume is only 1812000 tons) but the imports of Chinese grain trade on the virtual land increased rapidly during the past 13 years, the average annual growth rate being of 32%, except for 2002 there being a fall, the virtual land import volume increased year by year and reaching 31908000 hectares in 2010.

Compared with the imports, the exports of food trade on the virtual land are relatively small and so is the volatility. From 1978-1985, mainly because the corn export fluctuation, the export volume on virtual land in 1985 reached 2881500 hectares and then being a slight down, after the 1990 it reduced to 1480800 hectares; after that except for 1995 and 1996, along with the fluctuation of corn and rice export, the exports on virtual cultivated land experienced several fluctuations, in 2000 it reached 3133800 hectares; in 2003, after a slight fell, it reached a record high of 4840200 hectares; and then experiencing a

slight fluctuation, in 2009, the export volume of virtual cultivated land was 747300 hectares and in 2010 it was 1527300 hectares.

CONTRIBUTION OF VIRTUAL GRAIN CULTIVATED LAND TO SOWN ACREAGE AND ACREAGE UNDER CULTIVATION IN CHINA

The ratio that the China's import volume of virtual cultivated land to the cultivated area and sown area has a regularity. From 1978-2010, the ratio is shown in Fig. 2.

As can be seen in Fig. 2, from 1978-2010, two pieces of statistics showed basically consistent trends; from 1978 to 2010, the ratio that the grain imports of virtual land resource in China to the cultivated area and sown area had experienced three cycles (decreased after increased); it came into rising stage when it was into the fourth cycle since 1997; in the fourth cycle it showed a longer and stronger rising trend; in 2010, the imports of grain in virtual land resource has been equivalent to 30% of the cultivated area. But with the economic development the proportion could go up further; Chinese food imports of virtual land resource have become an important method to

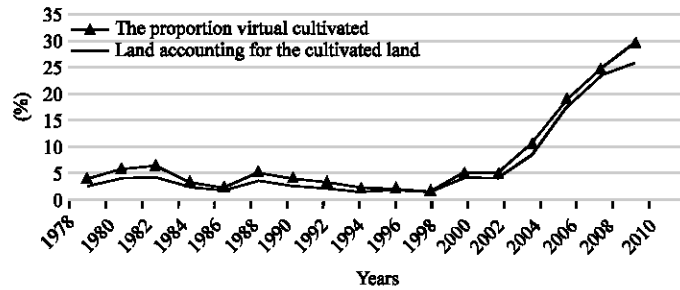


Fig. 2: Ratio of the major food variety import on virtual land to cultivated area and sown area in China from 1978 to 2010

solve the shortage of arable land. In 2010, for example, the virtual land resources of four main varieties of grain imports save the sown area of 31900000 hectares for China which are equivalent to 26% of the sown area and 29% of the cultivated area in China (Luo *et al.*, 2004; Hu *et al.*, 2006).

CONCLUSION AND SUGGESTION

According to the calculation method of virtual cultivated land in the study and estimating the volume of grain trade of virtual land in China from 1978 to 2010, we draw the following conclusions:

First, from 1978-2010, the foreign trade of 4 main Chinese grain, wheat, soybeans, rice and corn, on the virtual land had been maintaining a larger trade deficit, except for 1985, 1986, 1993 and 1994, the rest 29 years showed a net import state; only in 2010, the virtual land transactions amounted to 34962800 Hm² which the net imports in virtual land trade amounted to 33435500 Hm² and the net exports amounted to 1527300 Hm², the quantity of net imports of virtual cultivated land was 31908200 Hm². The net import quantity on virtual cultivated land and its proportion to the total area of cultivated land has a rapid increase which has an important practical significance to alleviate the pressure of cultivated land resources and protect the ecological environment, guarantee cultivated land and grain double security in China (Yan *et al.*, 2006a).

Second, the saving effect in China's foreign trade brought about by cultivated land resources is not synchronized with the balance situation of international grain trade. In this study, in the year of 1992.1997-2000 and 2002, there are different degrees of surplus in China's grain trade which showed a net export but the data display a deficit in virtual cultivated land trade in recent years which showed a net import, it means that the net surplus of grain during these years made a contribution to save land resources of china. So when talking about the relationship between foreign trade of cultivated land

resources and grain, the net exports in food trade may not be a cause of cultivated land resources; on the contrary, the net imports of grain trade may not bring the net imports of cultivated land resources, the key lies in the structure of import and export of foreign trade of grain. Therefore, the analysis of improving the benefit of cultivated land resources in the foreign trade of grain should be based on the different yield of different intensive products of different cultivated land unit area and to optimize the cultivated land intensive cultivation and export structure, rather than blindly pursuing trade surplus or deficit (Yan *et al.*, 2007; Yan *et al.*, 2006b).

Third, according to the above calculation result, the food products trade volume in the virtual land trade depends on two aspects of factors: product trade and crop yield. From four kinds of food products involved in this study, we list the crop yield from low to high order which is soybean, wheat, corn and rice. Therefore, to adjust product structure of trade on the premise of ensuring food security, economic and social security and economic benefits, China should expand the imports of the low amount of food varieties, implement the import substitution policies to save the country cultivated land resources, while in exports we can use corn and rice with higher yield as dominant, synchronously improving the benefit of foreign grain trade environment. What we should notice is that, compared with a variety of grain, the soybean's yield is much lower but due to the particularity of its products, especially as the legume crops in use and nourishing of the land with the special function and therefore, in trade it cannot simply be regarded as general food crops.

Finally, the virtual land trade can alleviate the pressure of cultivated land resources in China and provide a new way to alleviate the shortage of cultivated land but the virtual land strategy can not solve all the problems of the shortage of cultivated land from the bottom and the practical application is very complex which is affected by many factors. In addition, the implementation of the virtual land strategy may achieve a

balance of cultivated land from a macro point but also may cause new problems, such as excessive exploitation of land resources; if a country or a region has an excessive dependence on trade, it may increase the risk of economic development of heteronomy and will threaten food security, if not taking timely and effective measures which may also lead to new environmental and social problems. Therefore, the urgent need is to strengthen the researches in this area, such as the use of food safety and the virtual land strategy, the ecological, economic and social and cultural influences to the cultivated land resources brought by the implementation of the virtual land strategy, from the perspective of the virtual land strategy, we should try to build the new management mode with the sustainable utilization of the cultivated land resources in order to realize the land resource optimized configuration.

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