Research on Export Promotion Mechanism of Agricultural Products Based on Cournot Model in the Context of Carbon Trading

Qi Wei[1,a], Zhaoying Zhou[1,b], Dongliang Li[1,c]

Email: weiq@lut.cn[a], Email: 1483821716@qq.com[b], Email: 377973647@qq.com[c]

School of Economics and Management, Lanzhou University of Technology, Lanzhou 730050, China[1]

Abstract: Under the background that environmental protection has been paid more and more attention by various countries, China's agricultural export enterprises often encounter the problem of technical barriers to trade with importing countries when carrying out foreign trade because the products are not up to standard. Under the background of carbon trading, Cournot game model under the condition of complete information is established based on the production and operation behavior of agricultural export enterprises, studies the changes of corporate profits under the changes of carbon price, cost increase caused by product quality improvement and carbon sink quantity in the duopoly market, analyzes the benefit conditions of agricultural export enterprises after participating in carbon trading, and draws the following conclusions: Agricultural export enterprises can benefit from introducing carbon trading mechanism ; Under the same agricultural output , the increase in carbon sink per unit of agricultural product will increase the income of producers . A stable carbon price is crucial to the long-term implementation of the whole mechanism. Based on the above conclusions, this paper puts forward the following suggestions: to maintain a reasonable and stable carbon trading price, the government should increase policy support and subsidies, and enterprises should develop low-carbon agriculture according to local conditions.

Keywords: Carbon trading; Agricultural exports; Cournot model; Duopoly model

1 INTRODUCTION

From the perspective of global agricultural production standards, the use of chemical fertilizers and pesticides in China's agricultural production are still at a high level compared with other countries, and the negative effects of massive use of chemical fertilizers and pesticides are gradually highlighted in two aspects. First of all, due to the excessive use of pesticides and fertilizers, agricultural and veterinary drug residues do not meet the maximum limit standards of importing countries, many of China's exported agricultural products were detained and returned by relevant foreign departments. Many developed countries have established a set of comprehensive certification system including all kinds of technical standards, third-party

ICIDC 2022, June 17-19, Qingdao, People's Republic of China

DOI 10.4108/eai.17-6-2022.2322611

certification and strict packaging label transportation requirements. This system objectively leads to the export of agricultural products of China is facing many adverse terms, forming technical trade barriers.

Secondly, from the perspective of agricultural carbon emissions, the massive use of chemical fertilizers and pesticides will aggravate the greenhouse gas emissions of agricultural production activities. The total greenhouse gas emissions from agricultural activities in China in 2014 amounted to 830 million tons of CO2 equivalent, accounting for 6.7% of China's total emissions. Under the background of carbon neutrality goal, the significance of vigorously developing low-carbon agriculture in promoting energy conservation and emission reduction is becoming more and more important.

The National Plan for Sustainable Agricultural Development (2015-2030) proposes the establishment of agricultural carbon sink trading system to promote the low-carbon development of agriculture. Along with the improvement of the agricultural sector carbon trading mechanism, will effectively promote the development of green low carbon agriculture, in improving the quality of agricultural production and optimize the structure of original agricultural products, which both help agricultural products export enterprises to expand export channels and scale, and the reasonable and effective to reduce carbon emissions in agricultural production, and promote the development of low carbon agriculture in our country.

2 LITERATURE REVIEW

Many scholars have carried out a large number of studies on carbon trading mechanism in agriculture. On the necessity of agricultural carbon sink development, Many scholars suggested that agricultural carbon sequestration will reduce dependence on high-carbon means of production, change traditional farming methods and improve soil carbon sequestration[1-3]. On the establishment of agricultural carbon sink mechanism, Song Han et al. [4] based on the research on the development status of international agricultural soil carbon trading mechanism, it is suggested that China should promote the implementation of "independent emission reduction" strategy, strengthen the evaluation mechanism and standardization construction, and establish carbon sink trading product certification system. Buyuan Zhang et al.[5] studies the present situation of low carbon agriculture and carbon emission trading market in China, proposes to include agricultural carbon trading in carbon emission trading market, and probes into the development direction of agricultural carbon trading in carbon emission trading market. On the issue of low carbon agricultural compensation, Ru Chen et al.[6] studies the economic compensation mechanism of low-carbon agriculture, combines agricultural carbon measurement with conditional value evaluation method, and determines the ecological compensation amount of farmers' low-carbon agricultural production by using the data obtained from the survey.

On technical Barriers to Trade with agricultural products, Some scholars concluded that the improvement on pesticide residue requirements in western developed countries will affect the import and export of agricultural products, so enterprises should deal with technical barriers to trade through green product innovation and improve product quality[7-8]. Enterprises can effectively improve the external competitive environment and reduce technical barriers by cultivating green creativity and green competitive advantage of agricultural products and

strengthening agricultural technological innovation[9]. Some scholars suggested that enterprises strengthen the construction of food standards, improve food safety production technology, and awaken the awareness of social responsibility for food enterprises by studying the choice and decision on food enterprises under technical barriers to trade [10-11].

Existing researches mainly focused on agricultural carbon sink from the perspective of agricultural technology and agricultural development. On agricultural exports of technical barriers, the researchers put forward different direction of technological innovation to solve agricultural technical barriers to trade, but few scholars mention carbon trading mechanism on the role of agricultural exports, agricultural products export enterprises to participate in this paper mainly study carbon trading mechanism of benefit conditions, analysis of the carbon price, carbon number and other factors influence on agricultural product export profits, orderly and in view of the enterprise participation in carbon trading, give the rationalization suggestion to improve the quality of the product.

3 MODEL CONSTRUCTION AND ANALYSIS

3.1 Scheme Design

In order to avoid technical barriers to trade in agricultural exports, this paper designs schemes for agricultural export enterprises to improve product quality based on carbon trading mechanism, as shown in Figure 1. The program consists of three links, the core of which is agricultural export enterprises. Agricultural products export enterprises in the process of actual cultivation of agricultural production, to follow the foreign related agricultural products quality inspection standards, such as changing the situation of pesticide residue, making China's exports of agricultural products meet the standard, overseas technical trade barriers set up by the related barrier, the sales revenue will flow to the agricultural products export enterprises.

Agricultural export enterprises develop low-carbon agriculture in the actual production process. Since the crops themselves have the characteristics of absorbing carbon dioxide and carbon fixation in soil, the amount of carbon dioxide will be reduced and agricultural carbon sink will be generated. The trading right of agricultural carbon sinks generated to belong to agricultural export enterprises, which use the carbon trading market to sell agricultural carbon sinks, and the income generated by selling carbon sinks will flow to agricultural export enterprises.

Agricultural products export enterprises under this mechanism will receive income for the agricultural products export income and carbon sink sale income, under the condition of guarantee the basic profit, extra income will be conducive to further improve the crops and improve the enthusiasm of agricultural production technology. At the same time, agricultural products are rationally sold in both domestic and foreign markets. In export, due to the improvement of agricultural product quality, it will meet the product quality requirements set up by importing countries and avoid trade barriers. In the domestic market, it will rely on its advantages of low pollution, low residue and overseas standards to differentiate traditional local agricultural products from expensive imported agricultural products in the domestic agricultural market, and obtain a place through market segmentation.

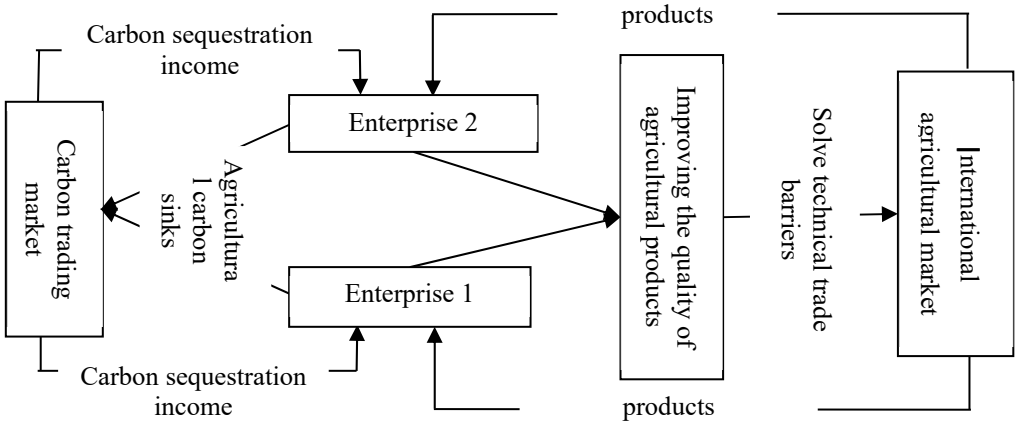

Figure 1. Scheme design of agricultural carbon trading mechanism

To verify the feasibility of the above ideas, this paper refers to Hongzhi Cao[12] According to the data of literature research, the following preliminary calculation is made. According to the data of Henan Province in odd years from 2000 to 2015 and based on the calculation method of agricultural carbon sink, the quantity of agricultural carbon sink in Henan province in 2015 is 3235.11 (10^4 t). Based on the calculation of the carbon sink price of 50 yuan per ton in Beijing Carbon Exchange on August 24, 2015, the total sales amount of carbon sink can reach 1.617 billion yuan. This part of income will be used in the improvement of crop quality and technological reform, which will help to avoid technical barriers to trade.

3.2 Basic assumptions and description

H1: In order to simulate the production and operation behavior of agricultural products enterprises after the introduction of carbon trading mechanism, this paper established Cournot duopoly model of enterprises under the carbon trading mechanism for game analysis[13].Suppose there are two agricultural export enterprises affected by technical barriers to trade in a certain region, agricultural export enterprise 1 and enterprise 2. Two companies with profit maximization as the goal, oligopoly competition characteristics, the two sides crop planting environment, planting form, planting technology, agricultural products export price is determined after the two sides in the overseas market information under the public game, agricultural product export enterprise their own production is $Q_i (i = 1,2)$ right now, agricultural products export prices is $P(Q_1 + Q_2)$, determined by the two companies.

H2: The current literature about solving agricultural technical barriers to trade are to improve agricultural production technology, improve the quality of agricultural products as the path to solve the problem of low carbon agricultural technology by optimizing the farmland mostly agronomic link in the production process, to increase effective output at the same time can reduce the content of input and greenhouse gas emissions, so the two companies to make the agricultural product export sales smoothly will use to grow new technology to improve the agricultural product quality standards, reduce pesticide residues, etc., the resulting increases production cost. With the increase of labor cost, the use of environmental protection equipment

and the improvement of green production technology, capital investment gradually increases. The additional cost is $S_g = 16\phi / 1 - \phi$, when ϕ is the efficiency of technological improvement of the enterprise.

H3 Considering from the actual situation of China's carbon trading market, assuming that agricultural products exported enterprises in the process of participating in carbon trading does not exist carbon sink fraud behavior, such as agricultural enterprises in the use of carbon trading mechanism when carbon quota can only be used when the cycle is used, there is no quota savings, overdraw, etc., therefore does not consider relevant cost benefit and opportunity loss and other problems. The transaction costs of emission data monitoring, verification, carbon asset management and exchange involved in the introduction of carbon trading mechanism will not be included in the production cost of enterprises for the time being.

H4 In this paper, agricultural enterprises are responsible for crop production and post-processing. In order to simplify the game process and mathematical model, grain crops are taken as the main research object. It is assumed that the accounting of grain carbon sink is divided into carbon absorption and carbon emission, and the greenhouse gases involved in farmland ecosystem mainly include CO2, CH4 and N2O, CH4, CO2 and N2O unified conversion into standard carbon measurement, accounting for the carbon absorption of various crops in a one-year cycle, C is the amount of carbon absorption of crops, A_j represents the economic yield of crops, α_j represents the economic coefficient of crops, β_j represents the dry-weight ratio, γ_j represents the carbon absorption rate, K represents the adjustment coefficient.

For the convenience of later discussion, specific symbol definitions are given in Table 1.

TABLE 1. MAIN PARAMETERS AND SYMBOLS

Parameters of the symbol	The parameter name	Parameters of the symbol	The parameter name
Q_i	Production of agricultural products of oligarch enterprises	C_a	Carbon uptake of crops
P	Export price of agricultural products per unit	A_j	Economic crop yield
S_g	The cost caused by the improvement of product quality	α_j	Crop economic coefficient
m	Corporate profits	β_j	Dry weight than
P_c	Carbon emission trading price	γ_j	Carbon absorption rate
J_i	Carbon sink per unit of agricultural products	K	Adjust the coefficient of
ϕ	The efficiency of enterprise technology improvement		

3.3 Analysis of benefit conditions of agricultural export enterprises

As the output of the enterprise is $Q_i (i = 1,2)$, the export price of agricultural products is $P(Q_1 + Q_2)$, the linear inverse demand function is $P(Q_1 + Q_2) = k - a(Q_1 + Q_2), (k>0,\ a>0)$, and the cost of agricultural product export enterprise is the quadratic function of its output, $S(Q_i) = \frac{1}{2} b Q_i^2, \quad (b>0)$. In the absence of carbon trading, the profit function of agricultural export enterprises is the difference between the export sales volume of agricultural products and the cost, namely:

$$\prod_i (Q_1, Q_2) = Q_i P(Q_1 + Q_2) - S(Q_i). i = 1,2 \tag{1}$$

Put $P(Q_1 + Q_2) = k - a(Q_1 + Q_2), (k>0,\ a>0)$ and $S(Q_i) = \frac{1}{2} b Q_i^2, \quad (b>0)$ into (1), the profit function is:

$$\prod_i (Q_1, Q_2) = -(a + \tfrac{1}{2} b) Q_1^2 - a Q_1 Q_2 + k Q_1 . i = 1,2 \tag{2}$$

After agricultural export enterprises participate in the carbon trading mechanism, the cost of planting crops will increase with the improvement of efficiency due to the improvement of agricultural products detection standard. As for the cost caused by the quality improvement of agricultural products, different enterprises have different efficiency in the process of quality improvement and process change, and the increase of efficiency value will also lead to the increase of cost. So that's the extra cost is $S_g = 16\Phi / 1 - \Phi$.

The trading price of carbon emission right is P_c, the carbon sink generated by each unit of agricultural product is J_i, and the carbon sink varies with the production scale and output of agricultural product. The profit function of agricultural products enterprises after the introduction of carbon trading mechanism is:

$$\prod_i (Q_1, Q_2) = Q_i P(Q_1 + Q_2) + J_i P_c - S(Q_i) - S_g Q_i, i = 1,2 \tag{3}$$

That is, the balance between the sum of the export income of agricultural products and the carbon sink income in the carbon market, and the original cost of planting agricultural products and the cost of improving the quality of agricultural products. According to Equations (1) to (3), the profit function of agricultural export enterprises is:

$$\prod_1 (Q_1, Q_2) = -(a + \tfrac{1}{2} b) Q_1^2 + (k - a Q_2 - S_g) Q_1 + J_i P_c \tag{4}$$

$$\prod_2 (Q_1, Q_2) = -(a + \tfrac{1}{2} b) Q_2^2 + (k - a Q_1 - S_g) Q_2 + J_i P_c \tag{5}$$

According to Equations (4) and (5), the production profit of agricultural export enterprises is determined by the quantity of agricultural production and export and agricultural carbon sink. At the same crop yield, in order to compare the profit situation and benefit possibility of agricultural enterprises before and after carbon trading, the partial derivative of output is obtained by formula (6) and Formula (7).

$$\frac{\partial \prod_1}{\partial Q_1} = -(2a+b)Q_1 + (k - aQ_2 - S_g) + P_c \frac{\partial J_1}{\partial Q_1} \tag{6}$$

$$\frac{\partial \prod_2}{\partial Q_2} = -(2a+b)Q_2 + (k - aQ_1 - S_g) + P_c \frac{\partial J_2}{\partial Q_2} \tag{7}$$

When Cournot model is satisfied, the output of two agricultural export enterprises is the same, and their second derivatives are the same, the following equation can be obtained:

$$\frac{\partial^2 \prod_1}{\partial {Q_1}^2} = \frac{\partial^2 \prod_2}{\partial {Q_2}^2} = -(2a+b) < 0 \tag{8}$$

Through the second derivative of formula (8), it can be seen that the profit of agricultural export enterprises is a concave function of the production quantity of agricultural products. After the introduction of carbon trading mechanism, there exists a maximum point Q, which makes the profit function reach a maximum value. Therefore, when the carbon trading mechanism is introduced, the profit of agricultural export enterprises increases gradually with the change of the export quantity of agricultural products, then reaches the peak, and then gradually decreases.

After the introduction of carbon trading mechanism, enterprise profits will change. Compared with that without the introduction of carbon trading mechanism, formula (4) is used to subtract Formula (2), and the change situation can be obtained after simplification. Here, the change range is expressed by m

$$m = J_i P_c - S_g Q_i \tag{9}$$

That is, the difference between the revenue from agricultural carbon sequestration sales and the additional cost of improving the quality of agricultural products. Different situations affect the benefits of agricultural export enterprises:

a) $m<0$, carbon sequestration income was less than the additional cost of improving the quality of agricultural products.

According to Formula (9), when $m<0$ occurs, the profits from selling agricultural carbon sequestration cannot offset the additional costs increased which called S_g by improving the quality and production technology of agricultural products.

b) $m \geq 0$, carbon sink income was higher than the additional cost caused by quality improvement. In this case, agricultural export enterprises could offset the cost caused by

improving agricultural product quality and farming technology by participating in carbon trading mechanism, and reduce the burden of enterprises to further enter overseas markets.

4 CALCULATION EXAMPLES AND ANALYSIS OF INFLUENCING FACTORS

4.1 Example analysis

Suppose that in a production cycle, there are two large agricultural export enterprises in a certain region operating under transparent information, the inverse demand function of the export of agricultural products is $P = 300 - 0.5(Q_1 + Q_2)$, the cost function of the production of agricultural products is $S = \frac{1}{2} * 0.5Q_1^2$, and the profit function of the two enterprises without the introduction of carbon trading is $\prod_i (Q_1, Q_2) = -(0.5 + \frac{1}{2} * 0.5)Q_1^2 - 0.5Q_1Q_2 + 300Q_1$. According to the equilibrium solution of Cournot model, it can be known that $Q_1 = Q_2 = 120$.

When agricultural products enterprises participate in carbon trading, according to the carbon price fluctuation range from 2018 to 2020 of China's pilot carbon exchange, this paper sets the carbon price at 40 for calculation. For the cost caused by the improvement of the quality of agricultural products, when $\phi = 0.5$, the cost S_g is 16. When the quantity of agricultural products Q_i exported by the two enterprises is 120, the agricultural carbon sink generated per unit of agricultural products is 40 in the first production cycle due to the lack of experience in the initial production period, and the two enterprises suffer profit loss. With the improvement of production technology, the agricultural carbon sink per unit reaches 48. At this time, the cost and income of the two enterprises reach a balance and the profit is $m = 0$. After obtaining preliminary experience, the two enterprises adjust the planting mode and planting scale, and then the amount of agricultural carbon sink of the cyclical enterprise increases to 50, when the profit is $m = 80$. It can be seen that the profits of the two agricultural export enterprises increased after participating in carbon trading, and the simulated profit changes are shown in Table 2:

TABLE 2. SIMULATES THE CHANGE OF ENTERPRISE'S PROFIT IN PRODUCTION CYCLE

m	J_i	P_c	S_g	Q_i
-320	40	40	16	120
-240	42	40	16	120
-160	44	40	16	120
-80	46	40	16	120
0	48	40	16	120
80	50	40	16	120
160	52	40	16	120
320	56	40	16	120

4.2 Analysis of influencing factors of carbon trading mechanism for agricultural products

The impact on profits which called m is largely determined by the carbon price, the additional costs associated with improving the quality and standards of agricultural products, and the number of carbon sinks produced per unit of agricultural product.

4.2.1 Influence of carbon price on profit

Can be seen in table 3, while the number of exports of agricultural products, agricultural products produced per unit of carbon sink capacity, to overcome the technical barriers to trade to improve agricultural products quality and standard of constant cost, along with the price of carbon sink, up from 10 to 60, export enterprises gradually increased profits by 1320 to 1680, it finally that carbon trading market prices of export firms have a direct effect on profit. Determining a reasonable carbon sink price will help enterprises to obtain stable carbon trading income. When the carbon price is too low, enterprises cannot make more profits through the carbon trading mechanism, or even bear a great burden due to the cost increase. In this case, enterprises will lack the willingness to ease technical trade barriers and develop low-carbon agriculture through the carbon trading mechanism.

TABLE 3. SENSITIVITY OF CARBON PRICE TO PROFIT

m	J_{i}	P_{c}	S_g	Q_i
-1320	60	10	16	120
-720	60	20	16	120
-120	60	30	16	120
480	60	40	16	120
1080	60	50	16	120
1680	60	60	16	120

TABLE 4. SENSITIVITY OF COST TO PROFIT CAUSED BY QUALITY

m	J_{i}	P_{c}	S_g	Q_i
1200	60	40	10	120
720	60	40	14	120
240	60	40	18	120
-240	60	40	22	120
-720	60	40	26	120
-1200	60	40	30	120

4.2.2 The impact of quality improvement costs on profits

Can be seen in table 4, while the number of exports of agricultural products, agricultural products produced per unit of carbon sink, carbon trading market under the condition of constant prices, improving the quality of agricultural products caused the cost which called increased from 10 to 30, agricultural enterprises profit from gradually decreased from 1200-1200, showed

that improving the quality of agricultural products caused by the high cost of generates a negative profit. Additional costs as to promote the efficiency of technology and gradually reduce, the early producers lack of related experience, unable to achieve the best production effect in actual production, but as the technology progress and the expansion of the scale of production, particularly agricultural companies take advantage of their own production management, the extra cost will reduce gradually, the profit increase.

4.2.3 Impact of agricultural carbon sink on profit

a) The impact on carbon sinks generated per unit of agricultural product of corporate profits .

Agricultural produce per unit amounts to agricultural carbon sinks for the change of corporate profits , based on the game analysis results as shown in table 5 , while the number of agricultural exports , to overcome technical barriers to trade to improve the cost of agricultural products quality and produce large carbon price unchanged , carbon trading market , the amount of carbon sink per unit of agricultural produce from 30 to 80 increases gradually , gradually increased profits by 720 to 1280 . It shows that the carbon emission per unit of agricultural product of the planting process will affect the final profit of the enterprise. The effect of carbon sink on final profit is positively correlated.

TABLE 5. INFLUENCE SENSITIVITY OF CARBON SINK QUANTITY PER UNIT OF AGRICULTURAL PRODUCT ON PROFIT

m	J_{i}	P_{c}	S_g	Q_i
-720	30	40	16	120
-320	40	40	16	120
80	50	40	16	120
480	60	40	16	120
880	70	40	16	120
1280	80	40	16	120

b) Factors affecting agricultural carbon sink in agricultural production process

From the analysis of agricultural product yield factors, the amount of agricultural carbon sink is positively correlated with agricultural output. The more crops are planted, the stronger carbon dioxide absorption capacity is. But at the same time, the amount of pesticides and fertilizers used is also increasing, which is another level of carbon dioxide emissions. From the analysis of land difference factors, taking Henan Province as an example, the carbon sink density of cultivated land in Zhoukou, Shangqiu and other cities in Henan province is large, and the carbon sink generation is higher than the average level of the province. Therefore, to find out the advantages of carbon trading mechanism, vigorously develop the cultivation of export agricultural products and change the traditional agricultural operation mode will improve the efficiency of agricultural production and crop export.

5 CONCLUSIONS AND SUGGESTIONS

This paper introduces carbon trading mechanism, reasonably increases the income of agricultural export enterprises to increase the technical input of enterprise products, improve the production technology level of enterprises and the quality of export agricultural products, in order to meet the international agricultural inspection and quarantine standards, so as to reduce trade barriers caused by technology and draw the following conclusions:

a) The introduction to carbon trading mechanism for agricultural export enterprises can achieve beneficial effects. b) In the case of the same output of agricultural products, the increase of carbon sink per unit of agricultural products will increase the income of producers and affect the gain effect of enterprises. c)The increased cost of improving product quality standards will affect the final profit results. The increased cost is influenced by the original technological level and efficiency of enterprises. The improvement to efficiency can reduce the increased cost of enterprises to avoid trade barriers. d) The carbon trading price will affect the ultimate benefits, and a reasonable and stable carbon price plays a key role in the long-term implementation of the whole mechanism.

In order to implement agricultural products bank enterprises and carbon trading mechanism and solve technical barriers to trade and other problems, this paper has the following suggestions based on model analysis:

a) Maintaining a stable carbon price. In order to stabilize the carbon price, the government and relevant regulatory departments should play a macro role in stabilizing the carbon price while the market influences the carbon price spontaneously. It is suggested to learning from the experience of European and American countries to regulate the supply of quota on the basis of reasonable monitoring of the carbon price. For example, the trigger price is setting in advance. When the carbon price is higher than the trigger price, the MARKET will sell CCR quota, and when the step price is lower, the buyback quota will reduce the supply.

b) To increase policy supports and subsidies, relevant government departments should actively explore various forms of support policy, the necessary subsidies support, in the aspect of technology promoted the cooperation colleges and universities and research institutions to create opportunities, and actively cooperate with other countries on international environment, lead and participate in relevant international standards, conformity assessment and the mechanism of mutual recognition.

c) Focusing on ecological and environmental governance and improvement. Guide enterprises to realize that the use of pesticides and fertilizers can be effectively reduced in terms of improving land production capacity and reducing the number of crop pests and diseases, and reduce additional costs. Enterprises have the responsibility to strengthen the protection and construction of ecological environment and carry out environmental purification actions in producing areas.

Acknowledgments: Fund Project: National Natural Science Foundation of China "Experimental study on the efficiency and regulation mechanism of carbon emission trading under uncertainty Impact" (71963024)

REFERENCES

[1] Shujuan Xie, Yaoqiu Kuang, Ningsheng Huang.China population, resources and environment,2010,20(12):46-51.

[2] Guanghe Ran, Jianhong Wang, Dingxiang Wang.Issues in agricultural economy,2011,32(02):32-38+110-111. (in Chinese)

[3] Yan Zhang, Yanbin Qi, Yang Jia.Issues in agricultural economy,2011,32(06):96-102.

[4] Song Han, Lu Qin, Jianlun Zhang.Current situation, problems and implications of international agricultural soil carbon trading mechanism [J]. World Agriculture,2014(08):38-42.

[5] Buyuan Zhang, Hongkai Zhang, Xiandong Hou.Environmental engineering,2016,34(S1):895-899+819. (in Chinese)

[6] Ru Chen, Zhide Jiang.Journal of arid land resources and environment,2018,32(09):63-70. (in Chinese with English abstract)

[7] Zhongmin Xie, Xinkai Zhu.Effects of foreign technical trade measures on China's agricultural exports: A case study of China's apple and garlic export [J].Journal of Huazhong Agricultural University (Social Science Edition),2019(02):46-54+165.

[8] Dongpo Jiang, Qingfang Yao.Effects of maximum residue limits on the quality of agricultural products: An empirical analysis based on the import of fresh fruit in Eu [J].Journal of Agro-Technical Economics,2019(03):132-144.

[9] Hong Tian, Lulin Chen.The impact of green product innovation on green competitive advantage: empirical data of agricultural products processing enterprises in Northeast China [J].Science and technology progress and countermeasures,2018,35(16):38-46.

[10] Chuan Hu, Yuanying Wei, Wei Hu.Journal of Agricultural Economics,2018(09):66-75. (in Chinese with English abstract)

[11] Yingou Dong, Junwen Huang. Effects of SPS measures on quality upgrading of export agricultural products: An empirical analysis based on frontier distance model [J].International Trade Issues,2018(10):45-57.

[12] Zhihong Cao, Shuai Qin, Jinmin Hao.Chinese journal of eco-agriculture,2018,26(09):1283-1290. (in Chinese)

[13] Yumei Hou, Deng Pan, Congzhi Liang.Research on production and emission reduction of duopoly enterprises under carbon emission trading [J]. Commercial Research,2013(01):176-182.