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Analysis of Decoupling Effect of China's Agricultural Carbon Emission

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Abstract. In this paper, the improved Divisia exponential decomposition method is adopted to decompose the driving factors of agricultural carbon emission growth into six major effects of theoretical carbon emission increase and theoretical carbon emission reduction. This paper analyzed the driving effect and decoupling state of China's agricultural carbon emission growth from 2000 to 2016 and found that the rapid growth of China's agricultural carbon emission over the long term was mainly caused by the slow inhibition of the effect of theoretical carbon emission reduction and the effect of theoretical carbon emission increase, China's agricultural carbon emissions and economic growth maintain a stable state of weak decoupling and have the potential to develop into a strong decoupling; Agricultural energy consumption efficiency, agricultural technological progress and improvement of farmers' living conditions are important policies to realize the ideal decoupling between agricultural carbon emissions and economic growth.

Keywords: Decoupling Effect, Carbon Emissions, Economic Growth.

1 Introduction

There are many domestic studies on the decoupling of carbon emissions from economic growth. For example, Ding Hao and Dai Rufeng [3] found that China's petrochemical industry was developing rapidly and its energy consumption increment was at a low level through establishing a 10-year carbon emission decoupling model; Liu Weibo [5] studied the output efficiency based on carbon emission constraint according to the industrial data of Henan province from 2000 to 2010 and put forward the specific ideas and countermeasures for adjusting industrial structure; Bai Juan [1] studied the factors influencing the decoupling of carbon emission from economic growth in China's transportation industry from 1995 to 2014 and their dynamic mechanism of action, they all used the basic decoupling theory to study the decoupling of industry carbon emissions from economic growth. In the study of agricultural carbon emissions, Zhang Yumei and Qiao Juan [8] used Tapio elastic analysis to analyze the relationship between urban agricultural development and agricultural carbon emissions in Beijing, and found that animal husbandry contributed the most to agricultural emissions reduction. Zhang Junbiao and Wu Xianrong's research [9] is more comprehensive, using an improved Divisia exponential decomposition, they divided the growth drivers of agricultural carbon emissions in China's provinces between 2002 and 2014 into five parts and concluded that the imbalance between the development of rural living standards and the regional development of low carbon agricultural technology is an important factor for the large difference in agricultural carbon emissions between regions. Shi Changliang et al. [7] used the LMDI decomposition method to conduct a quantitative analysis of China's agricultural energy consumption carbon emission over the past 30 years, and found that the decoupling state stability of China's energy consumption carbon emission from agricultural economic growth was poor.

It can be found that domestic research on carbon emission decoupling involves various fields, which are basically divided into two categories: one is the research on energy consumption carbon emission of a certain industry, and the other is the research on the relationship between carbon emission and economic growth of the industry. In the literature of agricultural carbon research, lack of their study is that without the energy consumption of agriculture and agricultural carbon decoupling research combine together, and the innovation of this paper lies in: the energy consumption of agriculture decoupling effect of the variable into the research of agricultural carbon decomposition model, a more comprehensive analysis of agricultural carbon emissions growth driving effect of the composition and the effect of decoupling state changes.

Therefore, this paper mainly USES the improved exponential decomposition method to decompose the decoupling effect of China's provincial carbon emission growth and studies the driving effect of the decoupling effect of each part.

2 Theories and Methods

2.1 Measurement of Agricultural Carbon Dioxide Emissions

The research on the measurement of agricultural carbon dioxide emissions at home and abroad is rather detailed. According to the specific practice in previous literature Tian Yun [6] this paper comprehensively and precisely classifies and calculates the carbon emissions of three parts of agriculture, and calculates and adds up the total amount of carbon emissions according to the IPCC(2006) carbon emission calculation formula [4]:

$$E = \sum_{i=1}^{n} E_i = \sum_{i=1}^{n} T_i \bullet \delta_i \qquad (1)$$

where E donates the total agricultural carbon emissions (unit: kg), E_i is agricultural carbon emissions of different carbon emission resources, T_i is the specific quantities or indicators of agricultural resources, δ_i is the carbon emission coefficient of various agricultural resources.

2.2 Tapio Decoupling Model

Decoupling concept. The word "decoupling" originally refers to the falling off of the link between trains. The OECD introduced the concept of decoupling into agricultural policy research at the end of the 20th century and gradually expanded it into areas such as the environment. Besides, "Carbon decoupling" is an idealized process in which the relationship between economic growth and greenhouse gas emissions is constantly weakened or even disappeared, that is, on the basis of economic growth, energy consumption is gradually reduced.

Decoupling criteria. The Tapio decoupling index analyzes the decoupling relationship between variables through the concept of "elasticity", which refers to the property that a variable changes in proportion to another variable. The definition is:

$$\mathrm{e} = \frac{\Delta CO_2 / CO_2}{\Delta GDP / GDP} \qquad (2)$$

where e is denotes the decoupling elasticity, CO_2 is agricultural carbon emissions, GDP is the total agricultural output. It can be found that the concept of elastic analysis can eliminate the dimensional constraints on decoupling elasticity, and the factor decomposition of decoupling index can be carried out by introducing one or more intermediate variables to facilitate the mathematical transformation and in-depth analysis.

2.3 Factor Decomposition of Decoupling Effect

Based on the original Kaya identities, due to the agricultural carbon emissions associated with the provinces domain agriculture total energy consumption, namely agricultural energy consumption is an important variable affecting agricultural carbon emissions, so this article is in Wu Xianrong decomposition based on the identity of the introduction of agricultural energy consumption such as variable (Ei) of agricultural carbon emissions of Chinese provinces domain driven factors are further broken down as follows: [9]

$$C = \sum_i C_i = \sum_i \frac{C_i}{E_i} \times \frac{E_i}{K_i} \times \frac{K_i}{Y_i} \times \frac{Y_i}{R_i} \times \frac{R_i}{P_i} \times P_i = \sum_i c_i \cdot e_i \cdot k_i \cdot y_i \cdot r_i \cdot p_i \qquad (3)$$

where, C_i refers to total agricultural carbon emission, E_i is the total agricultural energy consumption, K_i is the total agricultural production input, Y_i is the total agricultural output, R_i is the rural population and P_i is the total population. $c_i = C_i / E_i$ is the carbon efficiency, $e_i = E_i / K_i$ is the indirect energy consumption intensity, $k_i = K_i / Y_i$ is the agricultural input output ratio, $y_i = Y_i / R_i$ is the gross output per capital of agricultural, $r_i = R_i / P_i$ is the reverse urbanization level,and $p_i = P_i$ is the population size.

So *formula(3)* said: agricultural emissions into - carbon energy efficiency effect, indirect energy consumption intensity effect, technology effect, farmers life improvement effect, reverse effects of urbanization and population scale effect the product of the six effect, i.e., the change of agricultural carbon emissions depends on the change of the six parts effect.

By using the LMDI addition and analysis method, the change amount of agricultural carbon emissions relative to the base period can be expressed as the following formula:

$$\Delta C = C_t \cdot C_0$$
$$\Delta C = \sum c_{i,t} \cdot e_t \cdot k_t \cdot y_t \cdot r_t \cdot p_t \cdot \sum c_{i,0} \cdot e_0 \cdot k_0 \cdot y_0 \cdot r_0 \cdot p_0$$
$$\Delta C = \Delta C_c + \Delta C_e + \Delta C_k + \Delta C_y + \Delta C_r + \Delta C_p + \Delta C_\varphi \tag{4}$$

whereas, Δ represents the agricultural carbon emissions generated by the six effects respectively, ΔC_φ represents the agricultural carbon emissions generated by the six effects respectively, is the decomposition residue, and represents the part that may lead to the increase or decrease of agricultural carbon emissions except the six effects.

The six effects of the above exponential decomposition also have the following economic implications:

- Agricultural energy carbon emission efficiency effect, ΔC_c

Its value depends on two variables: total agricultural carbon emissions and agricultural energy consumption, which measures the amount of carbon emitted per unit of agricultural energy consumption. As the size of agricultural carbon emissions also depends on the size of agricultural energy consumption in the region, for two regions with the same agricultural energy consumption level in the same period, the smaller the carbon emission value reflects the smaller impact of agricultural energy emissions on environmental pollution in the region.

- Agricultural indirect energy consumption intensity effect, ΔC_e

The value depends on two variables: total agricultural carbon emissions and agricultural energy consumption, which measures the amount of carbon emitted per unit of agricultural energy consumption. The size of agricultural carbon emissions also depends on the amount of energy consumed by the region's agriculture.

- Agricultural technological progress effect, ΔC_k

It is the input/output ratio of agriculture that affects the change of its value. As the innovation of agricultural technology is an important link of energy conservation and emission reduction, it is reflected in the application and popularization of agricultural emerging technologies, which will improve the efficiency of agricultural utilization of natural resources and cause the change of agricultural carbon emissions, so it is the effect of agricultural technological progress.

- Improvement effect of farmers' life, ΔC_y

It is the "per capital output value effect", which is reflected in the improvement of farmers' living conditions. As a result of the rapid development of economy, urban water, electricity and gas can be introduced into rural areas, improving farmers' quality of life. Meanwhile, the use of water, electricity and gas will also bring more carbon emissions.

- Reverse urbanization effect, ΔC_r

The numerical value is the ratio of rural population to total population, while the reverse urbanization value decreases as the proportion of rural population to total population decreases. At this time, more and more people move to cities, leading to the increase of urban carbon emission, while the carbon emission in rural areas may be controlled.

- Population size effect, ΔC_p

This is reflected in the driving effect of population on agricultural carbon emissions. With the increase of population, it is inevitable to increase agricultural production input to meet the increase of demand for agricultural products. The increase of agricultural production input will inevitably lead to the increase of agricultural energy consumption, and eventually to the increase of agricultural carbon emissions.

Then, the factors of *formula(3)* were decomposed and the derivative was obtained, and the following formula was obtained:

$$\frac{\mathrm{d}C}{dt}=\sum_i\frac{c_i}{dt}\cdot e\cdot k\cdot y\cdot r\cdot p+\sum_i c\cdot\frac{e_i}{dt}\cdot k\cdot y\cdot r\cdot p+\sum_i c\cdot e\cdot\frac{k_i}{dt}\cdot y\cdot r\cdot p+\sum_i c\cdot e\cdot k\cdot\frac{y_i}{dt}\cdot r\cdot p+ \\ \sum_i c\cdot e\cdot k\cdot y\cdot\frac{r_i}{dt}\cdot p+\sum_i c\cdot e\cdot k\cdot y\cdot r\cdot\frac{p_i}{dt} \tag{5}$$

divide both sides of this equation by C, and you get:

$$\frac{1}{C}\cdot\frac{\mathrm{d}C}{dt}=\sum_i\frac{1}{c_i}\cdot\frac{dc_i}{dt}\cdot\frac{c_i}{C}\cdot e\cdot k\cdot y\cdot r\cdot p+\sum_i c\cdot\frac{1}{e_i}\cdot\frac{de_i}{dt}\cdot\frac{e_i}{C}\cdot k\cdot y\cdot r\cdot p+\sum_i c\cdot e\cdot\frac{1}{k_i}\cdot\frac{k_i}{dt}\cdot\frac{k_i}{C}\cdot y\cdot r\cdot p \\ +\sum_i c\cdot e\cdot k\cdot\frac{1}{y_i}\cdot\frac{y_i}{dt}\cdot\frac{y_i}{C}\cdot r\cdot p+\sum_i c\cdot e\cdot k\cdot y\cdot\frac{1}{r_i}\cdot\frac{r_i}{dt}\cdot\frac{r_i}{C}\cdot p+\sum_i c\cdot e\cdot k\cdot y\cdot r\cdot\frac{1}{p_i}\cdot\frac{p_i}{dt}\cdot\frac{p_i}{C} \tag{6}$$

by integrating the above *equation (6)* with the definite integral of 0-t, the following formula can be obtained:

$$\frac{\mathrm{dln}C}{dt}\cdot dt=\sum_i\frac{c\cdot e\cdot k\cdot y\cdot r\cdot p}{C}\left(\frac{d\ln c}{dt}+\frac{d\ln e}{dt}+\frac{d\ln k}{dt}+\frac{d\ln y}{dt}+\frac{d\ln r}{dt}+\frac{d\ln p}{dt}\right)dt \tag{7}$$

and let $T_i=(c\cdot e\cdot k\cdot y\cdot r\cdot p)/C$, and the above *equation (7)* can be rewritten as:

$$\frac{C_t}{C_0}=\exp(\sum_i T_i\cdot\ln\frac{c_t}{c_0})\cdot\exp(\sum_i T_i\cdot\ln\frac{e_t}{e_0})\cdot\exp(\sum_i T_i\cdot\ln\frac{k_t}{k_0})\cdot\exp(\sum_i T_i\cdot\ln\frac{y_t}{y_0})\cdot \\ \exp(\sum_i T_i\cdot\ln\frac{r_t}{r_0})\cdot\exp(\sum_i T_i\cdot\ln\frac{p_t}{p_0}) \tag{8}$$

taking the logarithm of both sides of the equation, we can get:

$$\ln\frac{C_t}{C_0}=\sum_i T_i\cdot\ln\frac{c_t}{c_0}+\sum_i T_i\cdot\ln\frac{e_t}{e_0}+\sum_i T_i\cdot\ln\frac{k_t}{k_0}+\sum_i T_i\cdot\ln\frac{y_t}{y_0}++\sum_i T_i\cdot\ln\frac{r_t}{r_0}+\sum_i T_i\cdot\ln\frac{p_t}{p_0} \tag{9}$$

as $C_t-C_0=\Delta C_{total}$,let $M=\frac{C_t-C_0}{\ln(C_t/C_0)}$,then the corresponding increment of each factor can be obtained:

$$\Delta C_{total}=M\cdot\ln\frac{C_t}{C_0}\quad\begin{cases}\Delta C_c=M\cdot\ln\frac{c_t}{c_0}\\ \Delta C_e=M\cdot\ln\frac{e_t}{e_0}\\ \Delta C_k=M\cdot\ln\frac{k_t}{k_0}\\ \Delta C_y=M\cdot\ln\frac{y_t}{y_0}\\ \Delta C_r=M\cdot\ln\frac{r_t}{r_0}\\ \Delta C_p=M\cdot\ln\frac{p_t}{p_0}\end{cases} \tag{10}$$

therefore, carbon emissions can be expressed as:

$$\Delta C=C_t-C_0=\Delta C_c+\Delta C_e+\Delta C_k+\Delta C_y+\Delta C_r+\Delta C_p \tag{11}$$

based on the above formula, the decoupling model of agricultural carbon emissions and economic growth can be decomposed into:

$$\begin{aligned}\gamma(CO_2,GDP)&=\frac{\Delta CO_2/CO_2}{\Delta GDP/GDP}=(\Delta C_c+\Delta C_e+\Delta C_k+\Delta C_y+\Delta C_r+\Delta C_p)\cdot\frac{GDP}{CO_2\cdot\Delta GDP}\\&=\frac{\Delta C_c/C}{\Delta GDP/GDP}+\frac{\Delta C_e/C}{\Delta GDP/GDP}+\frac{\Delta C_k/C}{\Delta GDP/GDP}+\frac{\Delta C_y/C}{\Delta GDP/GDP}+\frac{\Delta C_r/C}{\Delta GDP/GDP}+\frac{\Delta C_p/C}{\Delta GDP/GDP}\end{aligned} \tag{12}$$

that is,

$$\gamma=\gamma_c+\gamma_e+\gamma_k+\gamma_y+\gamma_r+\gamma_p \tag{13}$$

from *formula (13)*, we can clearly see that China's agricultural carbon emissions and decoupling of economic growth elasticity index($\gamma(CO_2,GDP)$) can be decomposed into carbon efficiency elasticity of decoupling, indirect energy consumption intensity of decoupling elasticity, the elasticity of input and output decoupling, the output value per capital decoupling elasticity, reverse decouple decoupling elasticity of urbanization and population scale elasticity, and respectively by six indicators $\gamma_c,\gamma_e,\gamma_k,\gamma_y,\gamma_r,\gamma_p$.

2.4 Data

This paper selects China's agricultural carbon emission data from 2000 to 2016 for calculation, the data of agricultural pesticides, agricultural film, etc. in farmland life utilization, the data of paddy field planting area and the data of livestock (cattle, horses, donkeys, etc.) are from *China Rural Statistical Yearbook (2000-2016)*. The data of agricultural production input, total agricultural output value and total population in China from 2000 to 2016 adopted in this paper are from *National Bureau of Statistics of China*. The data of agricultural energy consumption is calculated by the author based on the existing data of *China Energy Statistical Yearbook*. [2]

3 Results and Discussion

3.1 Analysis of the Decoupling Effect of China's Agricultural Carbon Dioxide Emissions

According to the economic implications of these six effects, it is easy to judge that in the rapid development of China's agricultural economy, the improvement effect of farmers' lives and the effect of population size are two important factors that cannot be ignored, which are regarded as the theoretical increase of agricultural carbon emissions. The four effects of agricultural energy carbon emission efficiency effect, agricultural indirect energy consumption intensity effect, general agricultural technological progress effect and reverse urbanization effect can be improved in some way to reduce agricultural carbon emissions. Therefore, we regard these four effects as theoretical reduction of agricultural carbon emissions.

Table 1. China's agricultural carbon emission driving effect factor decomposition. (unit: 10,000 tons of standard CO2).

year	ΔC	ΔCc	ΔCe	ΔCk	ΔCy	ΔCr	ΔCp
2001	-2,101.87	-7,706.14	1,074.76	422.96	5,675.04	-2,254.75	686.27
2002	-782.48	-9,184.95	3,745.71	1,553.58	4,733.42	-2,257.92	627.67
2003	-2,358.66	-16,747.38	2,200.06	12,583.03	1,321.48	-2,290.89	575.05
2004	3,729.26	-11,277.86	-3,001.99	-1,143.27	20,600.71	-2,014.36	566.02
2005	1,099.67	-11,414.90	-1,349.57	6,137.71	9,253.74	-2,109.48	582.17
2006	-258.66	-9,358.63	9,949.36	-10,067.17	11,077.75	-2,383.82	523.86
2007	1,430.82	-6,914.07	-10,389.46	5,155.60	15,875.60	-2,812.72	515.87
2008	1,495.06	-1,444.04	-15,220.58	5,125.68	14,600.25	-2,080.89	514.63
2009	1,791.98	-3,072.57	1,061.57	-5,770.56	11,732.28	-2,659.80	501.05
2010	989.89	-6,356.63	-6,637.75	-5,060.20	21,843.62	-3,299.07	499.93
2011	776.67	-6,654.90	-9,359.96	3,316.43	15,784.41	-2,813.40	504.10
2012	919.21	-3,138.64	-5,764.70	-2,001.24	14,165.95	-2,867.49	525.32
2013	899.85	-2,959.89	-4,453.37	-1,597.80	12,032.18	-2,647.70	526.43
2014	957.12	-1,320.23	-3,314.86	-1,058.71	8,543.98	-2,454.60	561.53

2015	412.50	-627.81	-4,534.19	39.62	8,236.03	-3,239.64	538.48
average	600.02	-6,545.24	-3,066.33	509.04	11,698.43	-2,545.77	549.89

According to the data in the table, except for the two periods from 2002 to 2003 and 2005 to 2006, China's agricultural carbon emissions have basically been increasing at a high speed since the 21st century. In particular, from 2007 to 2009, agricultural carbon emissions increased significantly, reaching 1,791.98 (10,000 tons of standard CO2) in 2009. The drastic reduction of China's agricultural carbon emissions in 2000-2001 was attributed to a series of energy-saving and emission reduction laws and regulations and policy measures implemented in 1998, which effectively reduced China's total agricultural carbon emissions. Similarly, the initial implementation effect of the "11th five-year plan" in 2006 was obvious, with agricultural carbon emissions falling by 258.66 (10,000 tons of standard CO_2) year-on-year. From the horizontal observation, we can find that the efficiency effect of agricultural energy carbon emission, the intensity effect of agricultural indirect energy consumption and the reverse urbanization effect have a stable negative driving effect on agricultural carbon emission over a long period of time.

It can also be found from the data in **Table 1.** that the growth of China's agricultural carbon emissions is basically driven by the high speed of part effect of theoretical increase and the slow drive of part effect of theoretical reduction. The rapid development of China's economy and the improvement of people's living standards since the 21st century are reflected in the significant positive promoting effect of the improvement effect of farmers' lives on China's agricultural carbon emissions. In 2010, its contribution to agricultural carbon emissions reached the peak, with year-on-year growth of 21,843.62 (10,000 tons of standard CO_2).The effect of agricultural technological progress on agricultural carbon emissions is not stable, and will promote the increase of agricultural carbon emissions, which aims to show that while focusing on improving agricultural production technologies, we should also vigorously advocate the concept of energy conservation and emission reduction, and improve the efficiency of resource utilization.

3.2 Decoupling of Carbon Emissions

Table 2. The decoupling of national agriculture carbon emissions from economic growth in 2000-2016.

year	△CO2/CO2	△GDP/GDP	elasticity	Decoupling state	Economic meaning
2000-2001	-0.0211	0.0425	-0.4960	strong decoupling	Carbon emissions are falling and the economy is growing
2001-2002	-0.0080	0.0324	-0.2472		
2002-2003	-0.0243	-0.0041	5.9200	recession decoupling	The rate of reduction in

					carbon emissions exceeds the rate of economic decline
2003-2004	0.0394	0.2198	0.1795	weak decoupling	The economic growth rate exceeds the carbon emission growth rate
2004-2005	0.0112	0.0813	0.1376		
2005-2006	-0.0026	0.0973	-0.0267	strong decoupling	Carbon emissions are falling and the economy is growing
2006-2007	0.0144	0.1457	0.0991	weak decoupling	The economic growth rate exceeds the carbon emission growth rate
2007-2008	0.0149	0.1373	0.1083		
2008-2009	0.0176	0.0975	0.1802		
2009-2010	0.0095	0.2003	0.0476		
2010-2011	0.0074	0.1366	0.0542		
2011-2012	0.0087	0.1179	0.0738		
2012-2013	0.0084	0.0971	0.0870		
2013-2014	0.0089	0.0636	0.1401		
2014-2015	0.0038	0.0523	0.0728		
2015-2016	-0.0524	0.0287	-1.8272	strong decoupling	Carbon emissions are falling and the economy is growing

On the whole, China's agricultural carbon emissions in 2000-2016 have been weakly decoupled from economic growth. The decoupling effect of agricultural development from 2000 to 2002 in strong decoupling by 2003 as the recession decoupling, the agricultural economic growth and energy conservation and emissions reduction effect is remarkable, even in 2003 brief decline in agricultural economy, agricultural carbon emissions is still obvious energy saving effect, thanks to China implemented on January 1, 1998 of the energy conservation law of the People's Republic of China and after a series of energy conservation and emissions reduction laws enacted.

From the decoupling state, although China's agricultural weak decoupling state is very stable, but there is a certain potential to develop strong decoupling. From 2005 to 2006 and from 2015 to 2016, three periods of agriculture in China are presented strong decoupling state, decoupling state is ideal, in 2006 and 2016, respectively, for the eleventh five-year plan in China and starting year "much starker choices-and graver consequences-in planning", clearly China's vision of the country's economic development has made the effective planning, green low carbon development has made some achievements, in response to the problem of global warming contribute force to be reckoned with.In 2016, with the progress of science and technology and the implementation of related policies, agricultural carbon decoupling is sustained strong decoupling of the ideal state, depending on the theory of agricultural carbon emission reduction four inhibition effect, improve agricultural technology progress by promoting agricultural technological innovation, and by improving the agricultural energy efficiency to reduce carbon emissions is effective and feasible measures.

From the perspective of the concrete numerical value of elasticity of decoupling, Chinese agriculture weak decoupling state for a long time, before 2008, weak decoupling elasticity has been slowly rising steadily, and from 2008 to 2010, the weak decoupling of elasticity decreased from 0.180 to 0.048, is affected by the financial crisis of 2008, China's agricultural products prices are falling, farmer production enthusiasm decline, agricultural technology advancement effect and improve farmers life effect both promote decline, although led to a decline in agriculture decoupling elasticity, but still keep the weak state of decoupling, consumes a lot of energy at the same time does not keep a higher level of economic growth.

3.3 Comparative Analysis of Decoupling Elasticity

Based on the addition and decomposition of the national agricultural data by the exponential decomposition method, the decoupling elasticity of the driving factors for the growth of agricultural carbon emission in each part is obtained. The results are as follows:

Table 3. Agricultural carbon growth effect decoupled elasticity.

year	γc	γe	γk	γy	γr	γp
2001	-1.82	0.25	0.1	1.34	-0.53	0.16
2002	-2.9	1.18	0.49	1.5	-0.71	0.2
2003	-1.72	-5.52	0.22	-3.32	5.75	-1.44
2004	-0.54	-0.14	-0.06	0.99	-0.1	0.03
2005	-1.43	-0.17	0.77	1.16	-0.26	0.07
2006	-0.97	1.03	-1.04	1.15	-0.25	0.05
2007	-0.48	-0.72	0.36	1.1	-0.19	0.04
2008	-0.1	-1.1	0.37	1.06	-0.15	0.04
2009	-0.31	0.11	-0.58	1.18	-0.27	0.05
2010	-0.31	-0.32	-0.24	1.05	-0.16	0.02
2011	-0.46	-0.65	0.23	1.1	-0.2	0.04
2012	-0.25	-0.46	-0.16	1.14	-0.23	0.04
2013	-0.29	-0.43	-0.15	1.16	-0.26	0.05

2014	-0.19	-0.49	-0.16	1.25	-0.36	0.08
2015	-0.11	-0.8	0.01	1.45	-0.57	0.1

Based on the decoupling of the driving factors of China's agricultural carbon emissions and economic growth from 2000 to 2015, it is found that:

(i) On the whole, among the decoupling elasticity of six major driving effects of agricultural carbon emission, the decoupling elasticity of agricultural energy carbon emission efficiency elasticity and reverse urbanization effect basically maintains a stable strong decoupling state, indicating that the relationship between the driving amount of agricultural carbon emission and economic growth has reached an ideal state.

(ii) Indirect effects of energy consumption intensity of agriculture and agricultural technology progress effect and size effect of the elastic state basic transformation between strong decoupling and weak decoupling, speculated that China's agriculture in the two aspects of indirect energy consumption intensity and technological progress to adjust to achieve the ideal of strong decoupling condition is feasible, therefore, push forward the reform of agricultural energy consumption structure and technological innovation is due, can practice the policy of energy saving and emission reduction measures;

(iii) The decoupling elastic state of the improvement effect of farmers' lives was in the growth connection state between 2003 and 2013, that is, the agricultural carbon emission and economic level were both in the growth state, while the decoupling elastic value between 2000 and 2002 and 2013 and 2015 was greater than 1.2, which represented the expansion negative decoupling, and its economic implication was as follows: Farmers life improvement effect driven by carbon emissions growth rate exceeded the rate of economic growth, and this state is not in conformity with the concept of sustainable development, thus to promote energy conservation and emissions reduction and recycling of the concept of green agricultural products to set up the rural people's consciousness of energy conservation and environmental protection, while economic growth slow the growth of agricultural carbon emissions of life appropriately.

4 Conclusion

- In the analysis of the decomposition of the driving factors of agricultural carbon emissions in China from 2001 to 2015, we classify them into two categories. Compared with the results of Wu Xianrong's decomposition of the driving factors of agricultural carbon emissions in China's provinces, the driving directions of the five effects are consistent with the results of his analysis (except for the newly introduced indirect energy consumption intensity effect), indicating that the analysis results of this paper are of certain reliability.

- From the results of quantitative analysis, we can find that the drastic reduction of China's agricultural carbon emissions in 2000-2001 was largely attributed to the series of laws and regulations on energy conservation and emission reduction initiated by China in 1998 and the policy measures adopted. Similarly, the preliminary implementation of China's 11th five-year plan in 2006, while ensuring the steady development of China's agriculture, has gradually implemented the low carbon policy and achieved remarkable results. Agricultural carbon emissions in that year decreased by 2,586,600 (10,000 tons of standard CO_2).
- The growth of China's agricultural carbon emissions is basically driven by the high speed of partial effect of theoretical increase and the slow drive of partial effect of theoretical reduction. The rapid development of China's economy and the improvement of people's living standards since the 21st century are reflected in the significant positive contribution of improvement effect of farmers' life to China's agricultural carbon emissions. In 2010, its contribution to agricultural carbon emissions reached the peak, with year-on-year growth of 21,843.62 (10,000 tons of standard CO_2) .The effect of agricultural technological progress on agricultural carbon emissions is not stable, and will promote the increase of agricultural carbon emissions, which aims to show that while focusing on improving agricultural production technologies, we should also vigorously advocate the concept of energy conservation and emission reduction, and improve the efficiency of resource utilization.
- In 2006 and 2016, for the eleventh five-year plan in China and starting year "much starker choices-and graver consequences-in planning", clearly China's vision of the country's economic development has made the effective planning, green low carbon development has made some achievements, in response to the problem of global warming contribute force to be reckoned with.
- According to the elastic index decomposition of the driving factors of agricultural carbon emissions, we can find that in terms of improving energy use efficiency and agricultural technology, the excessive use and waste of energy can be reduced by promoting agricultural technology innovation and implementing relevant emission reduction policies. While improving energy efficiency, farmers' awareness of low carbon also plays a great role in the reduction of agricultural carbon emissions. Therefore, it is necessary to actively establish farmers' awareness of environmental protection and advocate green ecological agriculture.
- The innovation of this paper is that the driving effect of agricultural indirect energy consumption intensity on China's agricultural carbon emissions is stable, and the quantitative inhibiting effect on carbon emissions is strengthened year by year. In a practical sense, the development of China's agriculture has improved the energy efficiency to a certain extent. However, limited by energy-saving and emission reduction technologies, China's agricultural energy efficiency is becoming limited. It is increasingly difficult to achieve strong decoupling of agricultural energy consumption carbon emissions by reducing energy consumption intensity. In this case, to realize the decoupling of China's agricultural energy consumption carbon emissions, the key is to strengthen source governance and actively promote energy conservation and emission reduction in the agricultural sector, so as to directly

reduce agricultural energy consumption from the source and finally achieve the effect of reducing energy consumption carbon emissions.

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