Discussions on optimizing the food system

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Abstract

Based on the discussion of sustainable development, we apply the decoupling model. By applying the decoupling theory, we associate the decoupling coefficient with the relationship between development and environment. In solve the problems of the food system, we put through to the total cost of the food production and food postpartum will eventually flow into the market we have done an assessment of its output, assess HLCC ratios is used to describe a variety of products in the final market proportion of the cost to describe the entire supply chain of added value, according to the national food volume and market price weighted average prices of grain, on this basis, it is concluded that the overall food system operation model, combined with market demand for the regional people's diet structure statistics, product consumption on the control, finally it is concluded that the overall gross grain production, in this model, the amount of food for the setting value, The structure shows that the error is less than 4%, and the model is feasible to simulate the grain system and the total output value. In this regard, after we study the sustainable development of the food system, we can improve the sustainability of the food system with favorable I value by timely adjustment and improvement. Given that the relevant effects need to be implemented three to five years ahead of time to gradually show benefits. For the model of food system, we can put the first priority as changing the dietary structure. Reducing the amount of meat can greatly improve the food system. The amount of meat per capita in developing countries is lower than that in developed countries, so the effect of changing dietary structure in developed countries will be greater than that in developing countries.

Keywords

Food system, Grey prediction, GM(1,1), Decoupling theory, Dietary pattern.

1. Introduction

To establish a food system model to solve the existing problems. This food system mainly needs to consider the optimization of sustainability and fairness on the basis of the current food system. An analysis of the possible benefits and costs of changing the priorities of the food system is required; In the process of building the model, both profitability and efficiency should be considered. Finally, we should try to apply the model to a developing country and a developed country for testing.

2. Model

2.1 Sustainable models for food production

Considering the use of chemical fertilizer and some environmental factors that affect the relationship of sustainable development in the production process, we use GM (1,1) model. Based on the data of fertilizer application from 2001 to 2014, this paper uses the grey GM (1,1) model, which introduces the decoupling theory, to identify the response relationship between agricultural production and non-point source pollution of chemical fertilizer in China, and discusses the effect of chemical fertilizer reduction caused by the implementation of this action from the perspectives of regional differences and fertilization structure differences. In 1982, Professor Deng Julong established a new theory which takes "small data, poor information" uncertain system as the research object, and the GM (1, 1) modeling method is the most typical one. Compared with other simulation methods such as regression analysis, GM (1,1) model has the advantages of small sample demand, simple modeling process and so on. It has been widely verified in many fields such as people's livelihood economy, resources and environment, ecological agriculture and so on, and has gradually become a mainstream scenario simulation modeling method. Grey prediction refers to the prediction of the development and change of the characteristic values of the system's behavior, the prediction of the system containing both known and uncertain information, that is, the prediction of the greying process that changes within a certain range and is related to the time series. Although the phenomena shown in the graying process are random and disorderly, they are ordered and bounded after all, so the data set obtained has potential laws. Grey prediction is to use this law to build a grey model to predict the grey system.

At present, the most widely used grey prediction model is GM(1,1) model, which is a variable of sequence prediction. It is based on the random original time series, and the law presented by the new time series formed after time accumulation can be approximated by the solution of the first-order linear differential equation. It is proved that the original time series revealed by the solution approximation of the first order linear differential equation change exponentially. Therefore, when the original time series implied the rule of exponential change, the prediction of grey model GM(1,1) is very successful, as show in Table 1.

Table 1: Chemical fertilizer pollution accounting unit

Sources of pollution	Survey unit	Accounting index	Calculation index
Agricultural fertilizer	Nitrogenous fertilizer	TN	Input (10000 tons)
	Phosphate fertilizer	TP	Input (10000 tons)
	Compound fertilizer	TN.TP	Input (10000 tons)

Formula is as follows:

$$\begin{cases} TN = \left(N + C \times \mathrm{N_C}\right) \times (1\text{-}\mathrm{U_N}) \\ \mathrm{TP} = (\mathrm{P} + \mathrm{C} \times \mathrm{P_C}) \times (1\text{-}\mathrm{U_P}) \times 43.66\% \\ EI = E / G \\ E = TN + TP \end{cases} \tag{1}$$

The format of GM (1,1) model is:

$$x^{(0)}(k) + Az^{(1)}(k) = b \tag{2}$$

Where: a is the development coefficient, b is the amount of ash, which can be converted into the bleaching equation after evolution:

$$\frac{dx^{(0)}}{dt} + ax^{(1)} = b \tag{3}$$

The test standard of the model is shown in Table 2.

Table 2: GM(1,1) model accuracy level

Accuracy class	Post residual ratio C	Error probability P
Good	<0.35	>0.95
Qualified	<0.50	>0.80
Barely qualified	<0.65	>0.70
Unqualified	≤0.65	≥0.70

2.2 Decoupling Theory

The decoupling index represents the ratio of the variable of chemical fertilizer pollution emission to the variable of agricultural output value. The expression is as follows:

$$I_{(E,G)} = \frac{(E_t - E_{t-1})/E_{t-1}}{(G_t - G_{t-1})/G_{t-1}} = \frac{V_t}{K_t} \tag{4}$$

$I_{(E,G)}$ is the decoupling index of agricultural production and chemical fertilizer non-point source pollution; E is chemical fertilizer pollution emission; G is the gross agricultural output value; T represents the statistical year; Is the growth rate of chemical fertilizer pollution emission in the t year; K, represents the growth rate of agricultural gross output value in the t year. Tapio took 0, 0.8 and 1.2 as the critical values to divide the decoupling elasticity index into 8 categories. Considering that the setting of elasticity values (such as 0.8 and 1.2) is subjective and prone to confusion, this paper, referring to research methods in the field of agro-environment, divides the decoupling state into the following 6 categories .Strong decoupling is the ideal state of agricultural economic development and environmental consumption, and strong negative decoupling represents the most unfavorable state of all decoupling relations.

According to the data of chemical fertilizer application in China in 2001 and 2014, the simulation equation of chemical fertilizer application based on GM(1, 1) model was obtained . MATLB software was used to simulate the amount of agricultural chemical fertilizer application in China from 2002 to 2017, and the comparison between the actual amount of chemical fertilizer application .Through calculation, it can be obtained that its posterior error test values are small probability error P =1 and variance ratio.= 0.213, the simulation accuracy is the first level, and the average relative error of the simulation is 0.020, indicating that the simulation results are effective. According to the simulation results, if there is no policy change, the total amount of chemical fertilizer application in China will continue to increase from the 5,919 million tons in 2014, and from 2015 to 2017, it will increase to 63.36 million tons, 66.484.81 million tons, and 6667.300 million tons respectively. Within 3 years after the implementation of the zero-growth action of chemical fertilizer, the actual application amount of chemical fertilizer decreased significantly compared with the simulated value, by 288, 500.71, and 8,083,100 tons, respectively, and the reduction amount increased year by year.

2.3 Food distribution model

The direction of grain after production mainly includes ration X, feed grain Y, processing grain Z, trade grain M, seed grain N, and wastage (12%).

For this reason, we set up some related models.

Considering the market conditions, the first model describes the market grain consumption in terms of standard dietary ratio, and the second model describes the market grain consumption in terms of China's dietary ratio in 2007. The total product consumption of the grain processing industry is calculated as 20% of the output quality of the ration and feed amount. People in urban and rural areas have different consumption patterns and structures in proportion. To facilitate our evaluation of a food system as a whole, we express the added value of food in industrial processing (q) for each industry in terms of profit/cost (q).

Q: GDP.The conversion rate of grain to feed grain was 0.69:1

3. Model Solving

3.1 Solution of GM (1, 1) model

Principle: in a data sequence generated by accumulating a set of new trend obvious data sequence, according to new data sequence is to predict the trend of growth model, and then evaluated using the method of b-b reverse calculation, restore the original data sequence, the prediction results is obtained.

Solving process of GM(1,1) :

(1) Set a group of original data as

$$x^{(0)}(k) = (x^{(0)}(1), x^{(2)}(2) \cdots x^{(0)}(n)) \tag{5}$$

n is the number of data. right $x^{(0)}$ In order to weaken the volatility and randomness of the random sequence, the new number is listed as:

$$x^{(1)}(k)=(x^{(1)}(1),x^{(1)}(2)\cdots x^{(1)}(n)) \tag{6}$$

Among them,

$$x^{(1)}(k)=\sum_{i=1}^{k}x^{(0)}(i);k=i,2\cdots n \tag{7}$$

(2) In generated $x^{(1)}$ Of the adjacent mean of the equal weight column

$$z^{(1)}=(x^{(1)}(2),x^{(1)}(3),\cdots,x^{(1)}(k));k=2,3\cdots n \tag{8}$$

Among them,

$$z^{(1)}(k)=0.5x^{(1)}(k-1)+0.5x^{(1)}(k),k=2,3\cdots n \tag{9}$$

(3) According to the grey theory $x^{(1)}$ A first-order unitary differential equation GM(1,1) about the albino form of T is established:

$$\frac{dx^{(1)}}{dt}+ax^{(1)}=u \tag{10}$$

a and u are the unsolved coefficients, which are respectively called the development coefficient and the gray action. The effective interval of a is (-2,2), and the matrix constituted by a and u is the gray parameter $\hat{a}=\begin{pmatrix}a\\u\end{pmatrix}$. We just have to figure out the parameter a and u, and we can figure out $x^{(1)}(t)$, and then solve for $x^{(0)}$ The predicted value of.

(4) Make the mean value of the accumulated data to generate vector B and constant term :

$$B=\begin{pmatrix}-z^{(1)}(2) & 1\\ -z^{(1)}(3) & 1\\ \vdots & \vdots\\ -z^{(1)}(n) & 1\end{pmatrix}=\begin{pmatrix}-\frac{1}{2}(x^{(1)}(1)+x^{(1)}(2)) & 1\\ -\frac{1}{2}(x^{(1)}(2)+x^{(1)}(3)) & 1\\ \vdots & \vdots\\ -\frac{1}{2}(x^{(1)}(n-1)+x^{(1)}(n)) & 1\end{pmatrix},Y_n=\begin{pmatrix}x^{(0)}(2)\\ x^{(0)}(3)\\ \vdots\\ x^{(0)}(n)\end{pmatrix} \tag{11}$$

(5) Use the least square method to solve the ash parameters $\hat{a}$,

$$\hat{a}=(B^TB)^{-1}B^TY_n \tag{12}$$

(6) will ash parameters $\hat{a}$ Plug in $\frac{dx^{(1)}}{dt}+ax^{(1)}=u$, and solve the $\frac{dx^{(1)}}{dt}+ax^{(1)}=u$, we can get

$$\hat{x}^{(1)}(t+1)=(x^{(1)}(1)-\frac{u}{a})e^{-at}+\frac{u}{a} \tag{13}$$

(7) The predicted value can be obtained by reducing the above results.

3.2 Solution of decoupling model

According to the existing data and the predicted value obtained from GM (1,1) model, the decoupling index can be calculated, which directly shows whether the increase of grain yield is at the cost of environment.

4. Conclusion

In the study of food fair, can we find a reasonable system to a great extent, guarantee the fairness of the grain, and within a reasonable diet, we have the most healthy diet structure and the current China's per capita diet two models, the average American diet and the average Chinese diet, that improve diet structure can solve the food problem on a large scale.

In this regard, after studying the sustainable development of the grain system, we found that it is recommended to improve the soil testing formula subsidy and organic fertilizer subsidy policy, and encourage farmers to use soil testing formula fertilizer and use more organic fertilizer, rather than simply reducing the amount of chemical fertilizer. Optimize the statistical system of agricultural industry, adjust the relevant statistical data of agricultural ecological value and agricultural waste resources, which are included in the output value of the tertiary industry, to the primary industry, and make accurate statistics of China's agricultural output value and related indicators. All regions should carry out annual evaluation of the zero-growth action of chemical fertilizer and incorporate it into the assessment mechanism of agricultural green development. Measures such as timely adjustment and improvement to solve problems can improve the sustainability of the grain system with favorable I value. Given that the relevant effects need to be implemented three to five years ahead of time to gradually show benefits.

Therefore, we can set the first priority as changing the dietary structure. Reducing the amount of meat can greatly improve the food system. Due to the limitation of development in developing countries, the amount of meat per capita is lower than that in developed countries. Therefore, the effect of changing dietary structure in developed countries will be greater than that in developing countries. In terms of scalability, this model is not applicable to small food systems. Because the price-benefit ratio is a system ratio based on a large range of industrial systems, neither a single product structure nor a single production method is applicable to this system. Generally speaking, due to different regions and people's eating habits in different countries, this model is not suitable for countries where vegetarianism is prevalent, and it is also not suitable for countries where the level of food industry is relatively backward and protein sources are decoupled from industrial production.

References

[1] Tianye Zhang,Analysis of contribution of zerogrowth action of chemical fertilizer to reduction of agricultural pollution[C], Resources and Environment in Yangtze Basin 2020.1.

[2] Wencong Lu,Research Center for Agricultural Modernization and RuralDevelopment[C], Chin a grain supply and demand change trend forecast Zhejiang University.

[3] ZhuZL,ChenDL,Nitrogen fertilizer use in ChinaContriButions to Foodproduction, impacts on t he environment and best management strategies[J], NutrientCycling in Agroecosystems, 2002, 63(2-3):11-127.

[4] XIA Y,ZHONG M C. Relationship between L,KC hypothesis and the decoupling of environme ntal pollution from economic development:Based on China prefecturelevel cities' decoupling pa rtition. China Population, Resources and L, nvironment, 2016, 26(10):8-16.

[5] Caballero,R .J.Consumption Puzzles and Precautionary Saving[J].Journal of Monetary Eco nomics 1990,(25):113-136.

[6] Dong Chaojun,Qiu Zulian. Particle Swarm Optimization Algorithm Based on the Idea of Simul ated Annealing[J].International Journal of Computer Science and Network Security, 2006, 16(10) :152-157.

[7] Jie Jing,Zhang Jing,Zheng Hui. Formalized mdel and analysis of mixed swarm based cooperati ve particle swarm optimization[J]. Neurocomputing.2016,174:542-552.

[8] Yuhong Wang,Qin Liu,Jianrong Tang, Optimization approach of background value and initial i tem for improving prediction precision of GM(1,1) model[J],Journalofsystems.Engineering and Electronics, 2014. 25(1):77-82.