

Environmental Assessment and International Competitiveness Analysis of Agricultural Fertilizer Industry in China

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Abstract:

In order to measure the social economic development, market demand and industrial policies among different fields, and evaluate the impact of the above three factors on the macro environment and international competitiveness of the fertilizer industry. Six countries including U. S. A., China, India, Brazil, Russia and Canada were selected as objects of this research, industrial environmental assessment index was adopted. The results indicate that the macro environment of China's fertilizer industry is comparatively advantageous compared with the major fertilizer producing and consumer countries in the world, given China's fertilizer industry ranking third in the comprehensive macro environment. However, according to the comparative analysis of social economy, market demand and industrial policy index, China's fertilizer respectively ranks the sixth, third and first, which presents that China's competitive advantage is not stable currently. In order to improve the international competitiveness of industry, fertilizer enterprises should actively "go out" and make effectively use of the opportunity of RCEP initiative, so as to further expand business and enhance international competitiveness. Additionally, our country is also expected to make policies properly to support and stimulate the industrial development of Chinese fertilizer enterprises and improve the international competitiveness of the industry, avoiding direct administrative intervention to enterprises and markets at full steam, and encouraging enterprises to increase the production of green, environmentally-friendly and high-efficiency fertilizer products which have higher quality and lower costs, so as to promote the optimization of the industrial structure of chemical fertilizer enterprises and the upgrading of the industry to accelerate the transformation and development.

Keywords: Fertilizer industry, International competitiveness, Comprehensive assessment index.

I. INTRODUCTION

The world these days stands in the period of great development, great revolution and adjustment, facing multiple risks referring to adjustment of international political pattern, economic acceleration and turbulence, instability of international trade, etc. With the above background, a new trend in the economic and trade activities of various countries characterized by "ensuring security and preventing risks" has appeared. There is a severe problem of food insecurity in the world, and uneven food supply is one of the

main reasons of this phenomenon. The boost of crop yield can only be achieved by increasing planting area and raising yield per unit. Chemical fertilizer is the main material production resource of grain production and the basis of grain yield increase[1]. China's grain competitiveness is currently insufficient, which causes the domestic market to be severely influenced by imported grains. To protect the grain industry in the long run, we must not only rely on domestic support, but also improve the international competitiveness of grain, which is the most key part[2]. China's chemical fertilizer industry must have higher production capacity than others to meet the needs of consumers and realize profitability.

II. TRADE PATTERN OF CHEMICAL FERTILIZER IN CHINA

2.1 Analysis on Import and Export of Chemical Fertilizer in China

China is a large chemical fertilizer producing country, but generally speaking, compared with the export volume, the China's export volume of chemical fertilizer only accounts for 45% of the output in 2020, which also embodies the small export scale of chemical fertilizer and weak market competitiveness. Specifically, China is a large chemical fertilizer producing country, as the national fertilizer output was 66.296 million tons and the total export volume was 35.97 million tons in 2015, which achieved the highest level in history, surpassing Russia becoming the largest fertilizer exporter in the world, but this also shows that the market competitiveness of chemical fertilizer in China is weak. Furthermore, because of the rapid expansion of domestic fertilizer production capacity and serious excess output, the export volume has been rising year by year, but the trade price has always been low internationally[3]. The specific reason for the export depression during the three years from 2016 to 2018 may be that a series of national measures of cutting overcapacity have recently been implemented, the fertilizer output is controlled gradually, the export volume begins to decrease, and the international competitiveness is weakened. In 2018, however, the country still controlled the production capacity and adjusted the industrial structure mainly, with the chemical fertilizer export of 25.56 million tons, which reached the lowest point in recent years. In the following two years, when the fertilizer industry would be over expanded and the production capacity and output would be extremely excessive, the country conducted the regulation and control policy. In 2020, the fertilizer export increased somewhat, bringing the whole fertilizer industry back to the rational adjustment stage, specifically compared with the export peak in 2015: the export of fertilizer reached 29.17 million tons and the export volume decreased by 18%. From 2011 to 2020, China's chemical fertilizer import and export volume presented the same fluctuation trend as the fertilizer output. It also demonstrates that the macro environment of fertilizer industry has great impact on fertilizer industry, which plays a necessary role in the sustainable development of fertilizer industry.

2.2 Analysis on Supply-demand Relationship of Chemical Fertilizer in China

Six countries including America, China, India, Brazil, Russia and Canada are selected as research objects, considering the current situation and competitive situation of chemical fertilizer industry around the world, and consumption mostly focusing on important agricultural areas and countries with high population density. Taking the distribution of fertilizer consumption in 2019 as an example, the top three countries were respectively America, India and China, whose average annual apparent fertilizer

consumption also achieved more than 10 million tons, becoming the most important fertilizer consumer in the world. In terms of market share, the proportion of domestic chemical fertilizer to consumption, only China and Russia account for a high proportion of localized fertilizer consumption, which showed that the impact of imported fertilizers was smaller than expected, and the local fertilizer had stronger competitiveness. Compared with 2015, however, the total amount of fertilizer consumption in China also indicated a downward trend, with a cumulative decrease of 17.59%. The above examples were all related to new environmental protection policies issued by China in recent years and fertilizer efficiency improvement. For example, in the *14th Five-Year Plan National Agricultural Rural Science and Technology Development Plan* issued by the Ministry of Agriculture and rural affairs, the fertilizer utilization ratio and pesticide utilization ratio are predicted to reach 43%, which also embodies the goal of achieving high-quality development with lower fertilizer and efficiency improvement, transformation and innovation and green environmental protection. What's more, for Canada, its apparent consumption is negative, which indicates that Canada's fertilizer industry is relatively mature and has already adapted to its own industrial environment. Canada represents the main producer of potash fertilizer and also the main exporter of fertilizer, 80% of which is international trade, and Asia is the world's most potash fertilizer deficient region with more than 80% of the consumption of potash fertilizer coming from import. See Table I for details.

TABLE I Supply-demand balance of chemical fertilizer in 2015 and 2019

Source: FAO database of the United Nations

III.	Country	2015				2019			
		Total fertilizer production (ten thousand tons)	Import and export difference (ten thousand tons)	Apparent consumption (ten thousand tons)	Proportion of national yield to consumption (%)	Total fertilizer production (ten thousand tons)	Import and export difference (ten thousand tons)	Apparent consumption (ten thousand tons)	Proportion of national yield to consumption (%)
	China	7432.00	-2439.42	4992.58	148.86%	5731.20	-1587.02	4144.18	138.30%
	USA	5655.45	2443.77	8099.22	69.83%	5848.73	2050.97	7899.70	74.04%
	India	4251.15	3160.09	7411.24	57.36%	4270.97	3279.67	7550.64	56.56%
	Brazil	1642.00	2138.90	3780.90	43.43%	503.27	3351.25	3854.52	13.06%
	Russia	4253.69	-3696.00	557.69	762.73%	4641.91	-4094.41	547.50	847.83%
	Canada	3027.10	-1669.24	1357.86	222.93%	1213.40	-1808.00	-594.60	-204.07%

RESEARCH METHODS

3.1 Data Source

The data of this paper come from World Bank database, FAO database and foreign trade inquiry service of the Ministry of Commerce People’s Republic of China. Six countries including USA, China, India, Brazil, Russia and Canada are selected as research objects. Since the data in 2020 is tough to obtain, three dimensions and seven variables of six countries in 2019 are selected as the variables of this paper for comparative analysis.

3.2 Construction of Industrial Environmental Assessment Index

Considering the measurement of industrial environment evaluation level, this paper adopts three-level index designed by Gao Li and others (2008), which mainly exists in different fields of social economic development, market demand and industrial policies, so as to find out the most competitive object through multi-objective comparative study, according to the characteristics of chemical fertilizer industry and the effect of competition environment change on industrial competitiveness. The assessment index of fertilizer industry environment matches with the actual situation of our country. Therefore, this paper refers to this measure index[4]. The index system is presented in Table II.

TABLE II Index system and weights constructed by Gao Li and others.

Target Layer	Domain Layer	Level II index layer	Index attribute
Environmental Assessment Level of Chemical Fertilizer Industry in China	Social economic development (0.2)	GDP per capita (0.3)	Positive
		Proportion of fertilizer yield to GDP (0.7)	Positive
	Market demand (0.3)	Agricultural production index (0.3)	Positive
		Market share (0.7)	Positive
	Industrial Policy (0.5)	Value Added Tax Rate (0.4)	Negative
		Tariff tendency (0.4)	Positive
		Environmental protection pressure (0.2)	Negative

3.3 Calculation Formula of Industrial Environmental Assessment Index

$$X = \sum Y_i * \alpha_i$$

$$Y_i = \sum Z_{ij} * \beta_{ij}$$

Among which, X——Environmental Assessment Level of Chemical Fertilizer Industry in China

Y_i---- Competitiveness index value of each 1-level indicator

α_i ---- The weight of each 1-level indicator

Z_{ij} ----- Competitiveness standard value of each 2-level index

β_{ij} ---- The weight of each 2-level indicator

On the basis of the order of each level, the environmental assessment level of fertilizer industry in 2019 can be produced. See Table III for detailed results.

TABLEIII Environmental assessment index of chemical fertilizer industry in China

Country	Level of social economic development	Market demand	Industrial Policy	Environmental Assessment Level of Fertilizer Industry
China	9.30	10.24	10.65	10.26
USA	9.91	9.13	10.49	9.96
India	10.1	9.61	8.97	9.39
Brazil	9.45	9.37	8.97	9.18
Russia	11.23	11.25	10.20	10.72
Canada	10.02	10.4	10.72	10.48

As displayed in the table, at present China's fertilizer industry has favorable comprehensive assessment index of favorable macro environment, whose comprehensive evaluation index ranks third after Russia and Canada. The specific reason may be that the chemical fertilizer industry of Russia and Canada is relatively mature and has already adapted to their respective industrial environment, becoming the greater competitors of China. However, the comprehensive index of fertilizer industry in the United States, India and Brazil is between 9-10 with smaller competitive advantage compared with other three countries, ranking near the bottom.

IV. SPECIFIC ANALYSIS OF RESULTS

From the term of social economy, market demand and industrial policies, because of the different advantages of different countries, the advantages and disadvantages of China's chemical fertilizer international competitiveness are analyzed through the results of these three aspects.

4.1 Social Economic Development

TABLEIV Environmental assessment index of market demand of chemical fertilizer industry in China

Country	GDP per capita	Proportion of fertilizer output value to GDP	Social economic development	Ranking
China	10217	4.00%	9.30	6
USA	65280	2.74%	9.91	4
India	2101	14.86%	10.1	2

Brazil	8897	5.92%	9.45	5
Russia	11498	27.08%	11.23	1
Canada	46327	6.99%	10.02	3

Fertilizer industry is a part of industrial development. According to the proportion of fertilizer output value to GDP, the results show that the social economic development environment faced by the fertilizer industry in the United States, Canada and Russia gives them a competitive advantage, which may be caused by the low cost of production entering the global market, with the policies of encouraging production carried out in China generally. However, China, India and Brazil face the lower social economic development environmental index. Although China is a big output country and an exporting country, China's chemical fertilizer production is highly dependent on natural resources. China's largest chemical fertilizer export product, urea, is highly dependent on India. At the same time, the export volume of potash fertilizer is small, which has little impact on the total export volume of chemical fertilizer in China. All of the above have caused the international competitiveness of China's chemical fertilizer industry to be weaker than that of the mentioned countries. Today, the main export area of urea in China is India. Specifically, these two indicators are both positive indicators affecting the environmental competitiveness of fertilizer industry. From the perspective of GDP per capita, developed countries represented by America, Russia and Canada have higher competitive advantages, while China, India and Brazil stand still in a weak position. According to the proportion of fertilizer output value in GDP, Russia, India, Canada and other countries hold a relatively high proportion of fertilizer industry, and thus it is easy to obtain better industrial development environment. China, India and other countries rank first in the industrial production index, mainly because of the rich resources in two countries. They are large fertilizer producing countries with many preferential policies and large domestic demand, which makes the entire industrial environment fully dynamic.

4.2 Environmental Analysis of Market Demand

TABLEV Environmental assessment index of market demand of chemical fertilizer industry in China

Country	Agricultural production index	Share of international market	Market demand environment	Ranking
China	104.1	10.99%	10.24	3
USA	100.5	3.62%	9.13	6
India	114.1	0.15%	9.61	4
Brazil	110.4	0.11%	9.37	5
Russia	110	16.31%	11.25	1
Canada	110.6	8.78%	10.4	2

The agricultural demand is the ultimate driving force for the development of fertilizer industry. At present, this comparative advantage is determined by the market demand structure of domestic and foreign faced by chemical fertilizer industry. Specifically, agricultural production index and international market share are both positive indicators affecting the international competitiveness of fertilizer industry. The higher these two indicators, the better the market demand environment and the stronger the international

competitiveness is. See Table V for environmental assessment index of market demand faced by fertilizer industry. According to agricultural production index and international market share, the results indicate that the market demand index of Russia and Canada ranks near the top with strongly competitive market demand environment. Russia has always been the main exporter of nitrogen fertilizer, phosphate fertilizer and potash fertilizer with relatively stable export volume, whose share of fertilizer in the international market remains 16.31%, much higher than other countries. China ranks three, whose competitive advantage of chemical fertilizer export is relatively weaker than that of Russia and Canada, compared with Russia and Canada. India, the United States, Brazil and other countries have a lower market demand index, and the market demand environment is poor. Both India and Brazil are net importers of nitrogen fertilizer, phosphate fertilizer and potash fertilizer, which account for very small proportions in the international market and are weaker competitive.

4.3 Environmental Analysis of Industrial Policies

TABLE VI Environmental assessment index of market demand of chemical fertilizer industry in China

Country	Value Added Tax Rate ¹	Tariff Tendency ²	Environmental pressure ²	Industrial Policy Environment	Ranking
China	9%	1	1	10.65	1
USA	10%	0	0	10.49	3
India	18%	-1	1	8.97	5
Brazil	18%	-1	1	8.97	5
Russia	20%	1	0	10.20	4
Canada	7%	0	0	10.72	2

Note 1: There is no VAT in the United States. Here, use sales tax instead of VAT. Brazil has 17%, 18% and 19% third-range rates. Here, use the average value of 18% for comparison.

Note 2: Both tariff tendency and environmental protection pressure take into account comprehensiveness and the difficulty of obtaining data. Thus, for tariffs, this article assigns value according to the import and export tax rate, countries encouraging export, and restricting import to score 1 point; countries restricting export and encouraging import to score -1 point, and countries encouraging free trade to score 0 point. For environmental pressure, data are difficult to obtain, and generally speaking, developed countries have higher expenditure on environmental protection, while less expenditure of developing countries. Therefore, the method of value assignment is also adopted, that is, developed countries to score 1 point and developing countries to score 0 points.

Industrial policy environment is the solid groundwork of fertilizer industry development. From the perspective of the value added tax and environmental expenditure, they are both the inverse indicators of industrial environment. In other words, the fertilizer industry environment of countries conducting low VAT or adopting low environmental expenditure has advantages, and since the tariff rates are adopted by each country differently, and many countries employ zero tariff policy, qualitative measurement is used in this paper. See Table VI for industrial environmental assessment index faced by fertilizer industry. In terms of value-added tax, the tax rates of Canada and China are lower, which enables the two countries have greater competitiveness, compared with more than 10% tax rates of other countries. Specifically, China carried out the policy of encouraging export of fertilizers against tariffs, with the provisional import tax

rate of 1%; the export tax rate still maintains 0 tariffs; China canceled fertilizer export tariffs to reduce export costs and improve international competitiveness in 2019. Compared with 2015, however, China exported less urea and potash fertilizer in 2019 than before, which showed that our international competitiveness is far less than before. The United States and Canada encourage free trade in the fertilizer industry, which employs tariff zero with free trade agreements; India's import tariffs are 7.5% CIF for imports; and Brazil has no import tariff rate. In addition, for environmental pressure, the stricter the environmental policies, the higher the operation cost of the enterprise are, and eventually reduces the profit of the enterprise. As developing countries, China, India and Brazil hold relatively weak competitive advantages internationally. In China, environmental protection and control of resource consumption will become increasingly strict, as many preferential policies in fertilizer production have been abolished in recent years, resulting in raising production cost of fertilizers.

V. CONCLUSIONS

Generally speaking, ranking the third of the comprehensive macro environment, China's fertilizer industry is advantageous to compete with global market. However, according to the comparative analysis of social economy, market demand and industrial policy indicators, China's fertilizer ranks respectively the sixth, third and first, which discloses that China's competitiveness is unstable currently. The reason why the social economy ranks close to the bottom may be the relatively increasing production cost of chemical fertilizer enterprises, therefore, decreasing the production cost and guaranteeing the product quality are the fundamental ways to internationally improve the competitiveness of chemical fertilizer in China. With the preferential policies of the country on fertilizer industry, China's chemical fertilizer enterprises are expected to actively "go out" and make use of the opportunity of RCEP initiative to strengthen cooperation with countries along the line, make good use of foreign production resources to reduce the cost of raw materials, strengthen international competitiveness and further expand international business. In addition, the country is also supposed to make policies appropriately to support and stimulate the industrial development of China's chemical fertilizer enterprises to improve the international competitiveness of the industry, trying to avoid direct administrative intervention to enterprises and markets and encouraging enterprises to enhance the production of green and environmentally friendly high-efficiency fertilizer products, so as to improve the quality and reduce costs, promote the optimization of the industrial structure of chemical fertilizer enterprises and the upgrading of the industry and accelerate the transformation and development. Therefore, the paper puts forward the countermeasure to solve the predicament to promote the better development of China's fertilizer industry, by analyzing the predicament of chemical fertilizer in China.

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REFERENCES

- [1] Zhang Xing, Zhu Yuhua, Gao Kuo, Jiang Hao. Research on World Fertilizer Industry Pattern and Competitiveness, *World Agriculture*, 2018(08):146-152.
- [2] Gao Li. Comprehensive Evaluation of International Competitiveness of China's Nitrogen Fertilizer Industry. Huazhong Agricultural University.
- [3] Cao Na, Xia Fei. Dilemma faced by China's chemical fertilizer export trade and countermeasures. *Phosphate fertilizer and compound fertilizer*, 2021,36(4):10-13.
- [4] Wen Qian, Wang Yuqian, Shang Jianzhuang, Wang Min. Development Analysis of Chemical Fertilizer Industry in China during the Fourteenth Five-Year Plan, *Chemical Industry*, 2019, 37(6):1-9.