

# Research on the International Competitiveness of Chinese Agricultural Machinery Products

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**ABSTRACT:** For modern agricultural production, agricultural machinery products are essential devices on enhancing the agricultural productivity, and hence, they are crucial commodities in international trade. In recent years, the export of agricultural machinery products from Chinese enterprises experienced a stable growth, one of the major reasons is lying on the saturated domestic demand for agricultural machinery products. With the support of regional governmental policies and international growing demand for agricultural machinery products, it is believed that the international market for agricultural machinery products is likely to expand and associated with ample opportunities, and hence, it is crucial to investigate the international competitiveness of Chinese agricultural machinery products.

This paper employs quantitative analysis and comparative research methodology to conduct the study on international competitiveness of Chinese agricultural machinery products. By referring to the information associated with the total export volume, export commodities structure, export market structure of Chinese agricultural machinery products, combined with the International Market Share (IMS), Trade Competition (TC), as well as Display Comparative Advantage (RCA) indexes, it is possible to determine the underlying reasons on why even though the international supply chain structure has undergone in-depth adjustments, coupled with increased level of uncertainties, and the entire global economy has fallen into a serious recession in the past five years, the export of Chinese agricultural machinery products remained stable and even growing at a constant rate. Moreover, this paper is also attempted to address the corresponding problems associated with the export of Chinese agricultural machinery products. Based on that, the corresponding countermeasures is proposed to improve the international competitiveness of Chinese agricultural machinery products.

**KEYWORDS:** Chinese agriculture machinery products, international competitiveness, associated problems, countermeasures

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## I. INTRODUCTION

At current stage, China is the world's largest producer of the agricultural machinery products, meanwhile, it is also the largest market for agricultural machinery products. However, due to the saturated domestic demand for agricultural machines, coupled with the continuous improvement of Chinese agricultural machinery technology and production capacity, the export of Chinese agricultural machinery products become an inevitable destination for majority of the agricultural machinery manufacturing enterprises. Since 2013, due to its reliable quality and affordable selling prices, Chinese agricultural machinery products have been exported to more than 100 countries around the world, involving United States, Russia, Japan, Australia, the European countries, the Africa countries, and the other countries in Asia. Among these markets, the export of agricultural machinery products to other countries in Asia accounts for roughly 30% of the total export volume, followed by European countries and Africa countries, each account for approximately 20% of the total export volume.

The core advantage of Chinese agricultural machinery products is depending on its completely independent supply chain, in other words, all individual components of the agricultural machinery products can be straightforwardly manufactured in China. Moreover, as supported by regional governmental policies, combined with the increased international market demand for agricultural machinery products due to the introduction of off-road machinery emission standards, the export of Chinese agricultural machinery products managed to achieve an average of 1.5% annual growth rate for the past five years. It is worth to note, the export of agricultural machinery products may also stimulate the export of other industrial components, which is beneficial for other domestic manufacturing and exporting enterprises. Therefore, it is essential to conduct our study on international competitiveness of Chinese agricultural machinery products, which enables the determination of the influencing factors and anticipation of the potentials for the entire industry. This paper is attempted to address the contemporary situation of export of Chinese agricultural machinery products with the

support of relevant data and literature. In addition to that, by referring to the International Market Share (IMS), Trade Competition (TC), as well as Display Comparative Advantage (RCA) indexes, it is possible to determine the dominant factors which are likely to influence the international competitiveness of Chinese agricultural machinery products. In addition to that, the comparison between Chinese agricultural machinery products and that of other exporting countries is also illustrated in this paper, which aims to identify the strength and weakness of Chinese agricultural machinery industry, and based on that, the corresponding countermeasures are proposed to tackle the factors which may hinder the development of Chinese agricultural machinery industry.

## II. LITERATURE REVIEW

Agricultural machinery products are important devices in the process of agricultural production to improve the productivity via transforming agricultural production methods. Despite the continuous expansion of export scale of Chinese agricultural machinery products, there is still a tremendous technological gap in contrast to that of developed countries (Xiaofeng, 2009), and majority of the agricultural machinery enterprises lack of brand awareness (Buwajie *et al.*, 2012). As specified by Chinese scholar Fang-fang Wang (2020), the total export volume of Chinese agricultural machinery products achieved a steady trend of increment and their international competitiveness has continuously increased since 2017. According to (Chunjie, 2018), it is believed that the ten ASEAN countries are the conventional targeting markets for the export of Chinese agricultural machinery products. Moreover, except for grain processing machines, there is a clearly increasing trend for the export of other Chinese agricultural machinery products (Ruimin *et al.*, 2016). When concerning with the exporting product structure and market structure, as indicated by Chinese scholar Yu-Lan Liu (2020), the major exporting Chinese agricultural machinery products are power conveying and harvesting machinery products, in addition to that, the exporting product structure was gradually diversified in the past five years. Furthermore, the targeting markets for the export of Chinese agricultural machinery products has been significantly enriched, the degree of dependency on limited trading partners has also reduced in recent years (Biao *et al.*, 2019).

As calculated by Xiao-Lu Lian (2004), the obtained result of international market share of Chinese agricultural machinery products reveals the overall level of international competitiveness demonstrates a constantly growing trend. Despite the development momentum of Chinese agricultural machinery industry is reasonable, but the overall international competitiveness of Chinese agricultural machinery products is relatively weak in contrast to the top-tier agricultural machinery exporting countries. In addition to that, the international competitiveness of different Chinese agricultural machinery products is completely divergent (Ju, 2007). A comprehensive analysis on the Display Comparative Advantage (RCA) indicator was conducted, the result indicates the RCA index of Chinese agricultural machinery products, in contrast to European and American exporting products, was continuously strengthened in the Central Asian markets. The weakness of Chinese agricultural machinery products is lying on the product quality and brand influence (Ruimin *et al.*, 2016). As pointed by Xiao-Yan Huang *et al.* (2021), there is no significant disparity among various agricultural machinery enterprises under different sectors of production, but the primary processing machinery products is the less competitive section within the entire industry.

To date, compare to strong international agricultural machinery manufacturing enterprises, most of Chinese firms are still in small to medium scale and are not specialized on their representing field. In addition to that, the imperfect industrial supply chain and lack of coordination among these firms are another two constraints which hinder the transformation and upgrading of the agricultural machinery industry (Guoliang and Mingshuang, 2021). In addition to that, by referring to the worsen global economic environment, political opposition and vicious competition, the exporting market condition for agricultural machinery products is not optimistic (Yujie, 2018). Moreover, agricultural machinery manufacturing and exporting firms have also been adversely affected by their foreign competitors, and how to deal with these competitors becomes a major challenge for Chinese firms (Yue, 2020).

In order to cope with the downturn of international economics and achieve healthy and sustainable development in the agricultural machinery industry, increasing the enterprises' technological innovation efforts is one approach. On the other hand, it is essential for government agencies to provide more political support and guidance for the entire industry (Juan, 2010). From the perspective of the enterprise, refining its product structure, increasing the level of research and development, promoting technological upgrading and transformation, and adopting appropriate quality and cost controlling measures may easily improve the overall product competitiveness (Nana, 2020). In addition to that, in order to improve the international competitiveness of Chinese agricultural machinery products, the enterprises should develop the customized products, accurately anticipate the market situation, and enhance the brand competitiveness by any means (Hongyan, 2021). From the perspective of the government agencies, it is believed that related government agencies should stimulate the international competitiveness of agricultural machinery products via issuing supporting policies and collaborate with the industrial associations in the refinement of the industrial standards (Chi and Guande, 2009). Moreover,

the government agencies should continue to encourage independent innovation of agricultural machinery enterprises, financially support the research and development of small to medium-sized enterprises, and focus on cultivating and exploring talents in international trade of agricultural machinery products (Mengzhou, 2020).

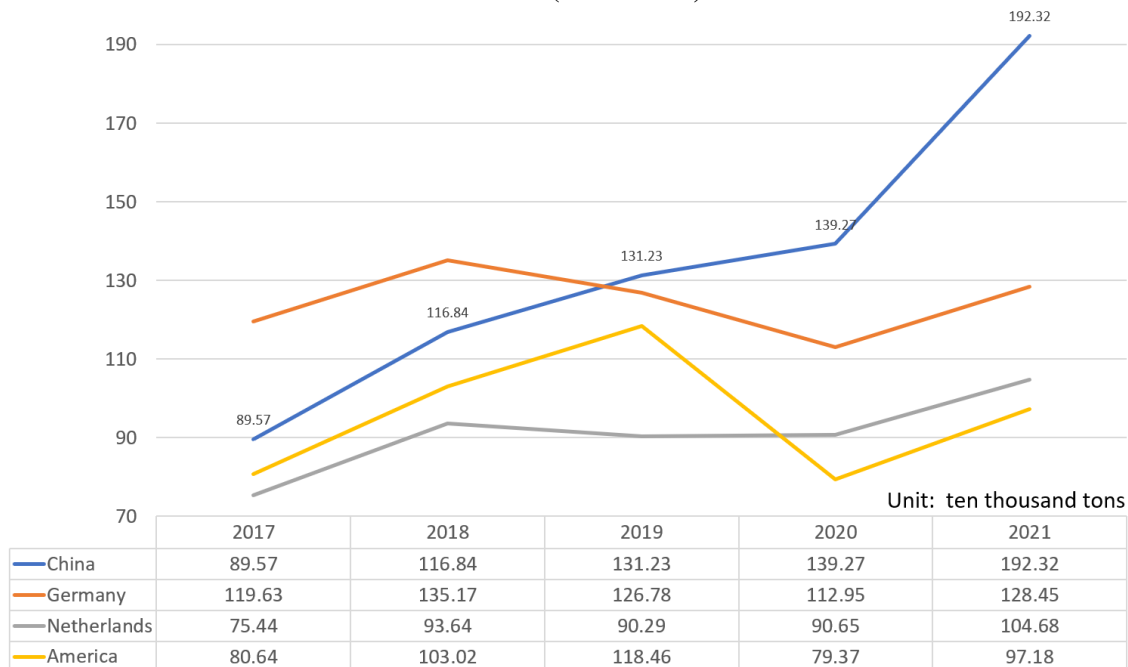
To date, majority of the existing literatures are either focusing on one particular market or interpreting the competitiveness of one specific agricultural machinery enterprise. There has been no macroscopic study conducted on the international competitiveness of the Chinese agricultural machinery products with respect to the entire industry. Moreover, the development of Chinese agricultural machinery industry is changing rapidly, and hence, many new problems have emerged in recent years that need to be addressed. Therefore, this paper is aiming to analyse the contemporary international competitiveness and existing problems associated with Chinese agricultural machinery products, coupled with the potential countermeasures.

### III. CURRENT SITUATION OF CHINESE AGRICULTURAL MACHINERY PRODUCTS

#### 3.1 Total Export Volume of Chinese Agricultural Machinery Products

As illustrated in Figure 1, the total export volume of Chinese agricultural machinery products continued to maintain an upward trend during the past five years from 2017 to 2021, the total export volume was more than doubled in 2021 compared to that of 2017. In addition to that, although the growth rate slowed down due to the impact of the global epidemic from 2019 to 2020, the curve still demonstrated a positive trend in contrast to other major agricultural machinery products exporting countries. There are many influencing factors which may be contributed to the increment of total export volume of Chinese agricultural machinery products, one reason is for certain, that is, multiple supporting policies on the agricultural machinery industry was released by regional government agencies. For instance, the policy of “promoting rural revitalization and accelerating agricultural and rural modernization” was proposed to improve the independent research and development capabilities of agricultural machinery enterprises, it supports the research and development of high-end intelligent and agricultural machinery equipment. In addition to that, the “14th Five Year Plan for National Economic and Social Development and the Outline of Long-term Objectives for 2035” mentioned the demand to strengthen the research and application of medium-sized, intelligent, and composite agricultural machinery products.

**Figure 1: Export Volume Among China and Other Major Agricultural Machinery Products Exporting Countries (2017 – 2021)**



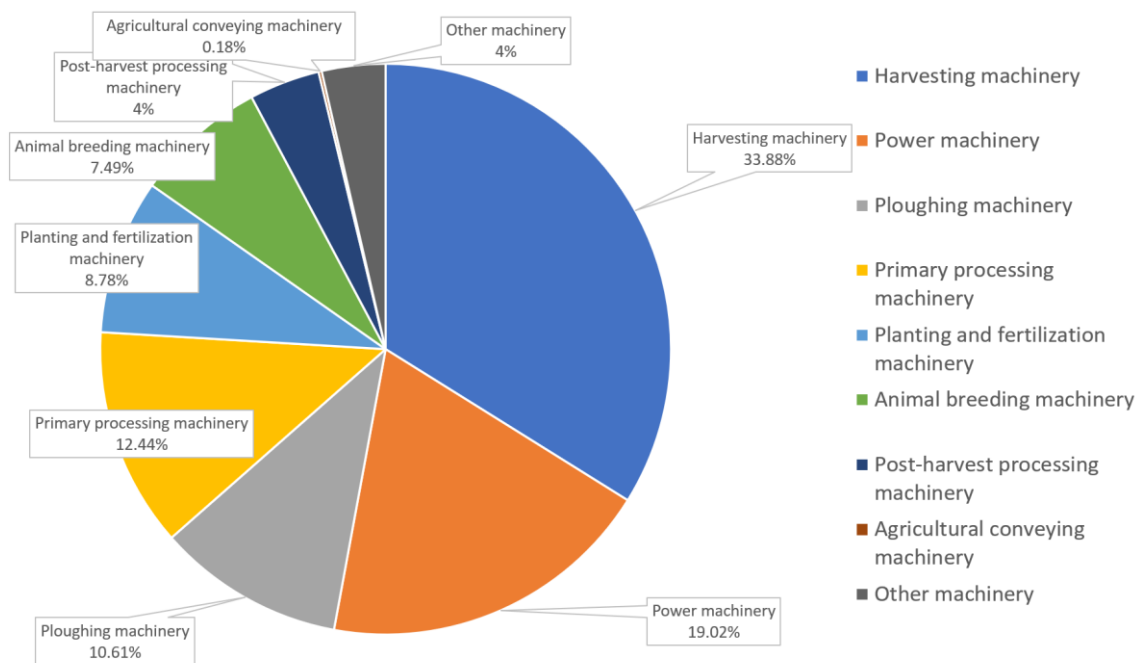
Source: UN Comtrade database

According to Figure 2, among all categories of exported agricultural machinery products, the harvesting machinery products is the top exporting products, which accounts for one-third of the total export volume. Moreover, the power machinery products contribute one-fifth of the total export volume and they are also belonging to major category of exporting agricultural machinery products. It is worth to note that the agricultural conveying machinery products only contribute for 0.18% of the total export volume. In summary,

harvesting machinery and power machinery products account for half portion of Chinese agricultural machinery exports and as these products represent the technological level of Chinese agricultural machinery products, the corresponding enterprises should pay more attention to the performance and quality of these products.

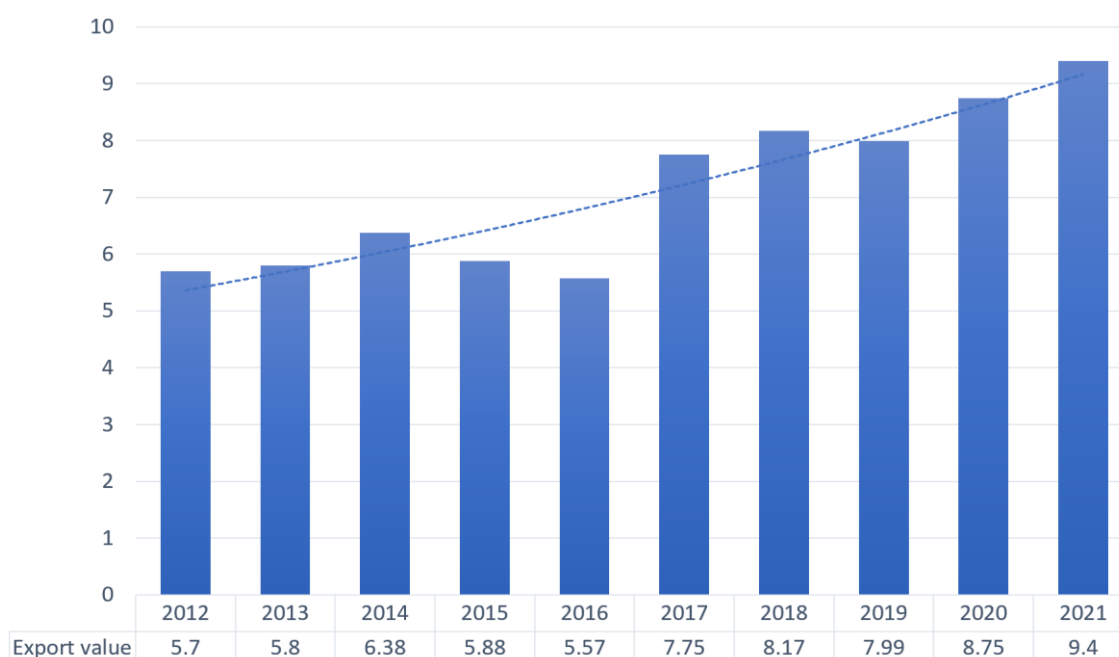
By referring to Figure 3, since 2012, the export value of Chinese agricultural machinery products has been hovering around 6 billion U.S. dollar from 2012 to 2016. The pace of increment initiated from 2017 and by 2020, the total export value reached 8.75 billion U.S. dollar which made China the third largest agricultural machinery exporter after Germany and the United States. The following parameters contributed to such increment including the political support by regional government agencies, production cost reduction via continuous refinement of manufacturing process and the alignment with mainstream agricultural machinery products. In 2021, Chinese agricultural machinery exports increased by 7.5% in contrast to previous year, reached the export value of 9.4 billion U.S. dollar. To date, even though there still exists certain technological gap between China and other strong agricultural machinery product exporting countries, typically the high-end international enterprises for agricultural machinery products. It is impossible to deny the truth that the Chinese enterprises have made significant refinements in technology associated with the agricultural machinery products, which is reflected by the significant increment in terms of the export volume.

**Figure 2: Export Volume of Different Classes of Chinese Agricultural Machinery Products (2021)**



Source: UN Comtrade database

**Figure 3: The Export Value of Chinese Agricultural Machinery Products from 2012 to 2021 (in billions of U.S. dollar)**



Source: Chinese Agricultural Machinery Industry Yearbook 2022

### 3.2 Export Product Structure of Chinese Agricultural Machinery Products

As depicted in Table 1, the export value of different classes of agricultural machinery products from 2017 to 2021, it is possible to conclude that the harvesting machinery products contributed the most amount of total export value. In addition to that, the primary processing machinery and power machinery products also account for nearly 20% of the overall export value. The data reveals the fact that the Chinese agricultural machinery export structure is relatively concentrated.

**Table 1: Export Value (in billion U.S. dollar) and Weightage of Various Classes of Agricultural Machinery Products**

Types of Agricultural Machinery Products	Year 2017		Year 2018		Year 2019		Year 2020		Year 2021	
	Export Value	%	Export Value	%	Export Value	%	Export Value	%	Export Value	%
Harvesting machinery	1.913	33.66%	1.977	33.77%	2.218	36.00%	2.520	39.18%	3.626	38.55%
Power machinery	0.836	14.71%	0.949	16.20%	1.026	16.66%	0.906	14.09%	1.750	18.60%
Primary processing machinery	1.19	20.94%	1.263	21.57%	1.263	20.51%	1.187	18.45%	1.622	17.24%
Ploughing machinery	0.367	6.45%	0.414	7.07%	0.355	5.76%	0.416	6.46%	0.620	6.59%
Animal breeding machinery	0.615	10.83%	0.488	8.33%	0.481	7.81%	0.494	7.68%	0.544	5.78%
Planting and fertilization machinery	0.272	4.79%	0.294	5.02%	0.295	4.79%	0.313	4.87%	0.480	5.10%
Post-harvest processing machinery	0.289	5.09%	0.270	4.60%	0.307	4.99%	0.326	5.07%	0.361	3.84%
Agricultural conveying machinery	0.009	0.15%	0.007	0.11%	0.005	0.08%	0.005	0.07%	0.009	0.09%
Other machinery	0.192	3.38%	0.195	3.33%	0.209	3.40%	0.266	4.14%	0.394	4.19%

Source: Chinese General Administration of Customs Database 2022

Under the duration of 2019 and 2020, within the context of most countries' lock-down countermeasures to the pandemic and trade unilateralism, the importance of food security was highlighted by most governments. Therefore, within these two years, lots of stimulating and subsidiary policies was issued by various governments which aims to stimulate the farming. The financial subsidies make agricultural machinery products affordable to more farmers in improving productivity, as a consequence, these stimulating policies promoted the rapid recovery of international market for agricultural machinery products. Generally speaking, Chinese agricultural machinery product export structure is demonstrating an optimized trend. Based upon contemporary situation, it is



necessary to maintain its major products, increase the corresponding investments on research and development, introduce modern technology, and continue to maintain its core competitive advantage.

For the remaining relatively vulnerable agricultural machinery products, involving the animal breeding machinery and post-harvest processing machinery, the deficiency was mainly caused by insufficient technological innovation and shortage of key technical components. In the future, in order to fulfill the growing market demands, Chinese agricultural machinery manufacturing enterprises will accelerate its transformation and development towards mechanization, scale, and standardization.

### 3.3 Exporting Market Structure of Chinese Agricultural Machinery Products

As indicated in Table 2, Chinese agricultural machinery products are mainly exported to the region of Asia, Europe, and North America. Among these regions, Asia is the largest targeting market, accounting for one-third of the total export volume. In 2017, the total export value of Chinese agricultural machinery products to Asia is 2.497 billion U.S. dollar, accounting for 39.14% of its total export value. By the end of 2020, the export value of Chinese agricultural machinery products to Asia increased to 2.82 billion U.S. dollar, accounted for 32.20% of increment, however, the proportion of exports to Asia region in total exports decreased by nearly 7%. Such figure illustrates that while Chinese agricultural machinery exports continue to grow, and its products are gradually moving towards other markets.

**Table 2: Market Structure of Exports of Chinese Agricultural Machinery Products (in billion U.S. dollar)**

Exporting Market	Year 2017		Year 2018		Year 2019		Year 2020	
	Export Value	%	Export Value	%	Export Value	%	Export Value	%
Global	6.38	100%	8.17	100%	7.99	100%	8.75	100%
Asia	2.497	39.14%	3.039	37.20%	2.794	35.00%	2.82	32.20%
Africa	0.615	9.64%	0.548	6.70%	0.676	8.50%	0.59	6.80%
Europe	1.306	20.47%	1.83	22.40%	1.914	24.00%	2.25	25.70%
Latin America	0.501	7.85%	0.621	7.60%	0.708	8.90%	0.79	9.00%
North America	1.312	20.56%	1.879	23.00%	1.553	19.40%	1.92	21.90%
Oceania	0.149	2.34%	0.253	3.10%	0.345	4.30%	0.38	4.40%

*Source: Chinese Agricultural Machinery Industry Yearbook 2021*

Meanwhile, the export of Chinese agricultural machinery products to European region as well as North American region continue to rise in recent five years, as contributed by the rising demand for agricultural machinery components and medium to large-size tractors. As these regions have their competitive agricultural machinery manufacturing enterprises, the rising market share of Chinese agricultural machinery products on these markets simply indicate that enterprises in China have achieved preliminary results in scientific research and investment in components that require precision production technology and medium to large-agricultural machinery. It is worth to note that the research and development process in European and American countries began much earlier. Due to relatively small arable land area of European countries, more refined agricultural production is needed, and hence, there is an urgent demand for small intelligent agricultural machinery products. Therefore, the agricultural machinery manufacturing firms in European countries have high achievements in the discipline of agricultural machinery intelligence. For instance, the mechanization and intelligence level of agriculture in Netherlands, which has reached the top level of world agriculture machinery products due to its intelligent technologies include greenhouse facilities, integrated water and fertilizer, and soilless cultivation. The situation in North America region is completely different, it has mass land coupled with sparse population, and hence, it demands for large agricultural machinery products, such as harvesting machinery, ploughing machinery, as well as planting and fertilization machinery. Therefore, the corresponding research and development investment should deliberately base upon different situations of targeting markets, by doing so, it is possible to increase the export volume of agricultural machinery products to these regions.

## IV. ANALYSIS OF INTERNATIONAL COMPETITIVENESS OF CHINESE AGRICULTURAL MACHINERY PRODUCTS

From current situation of export of Chinese agricultural machinery exports as specified in Section III, it is possible to observe that the export of Chinese agricultural machinery products has achieved stable increment in the past five years. In order to accurately reveal its international competitiveness, this section employs three indicators, namely, International Market Share (IMS), Trade Competition (TC), and Display Comparative Advantage (RCA) indexes, to illustrate the export competitiveness of Chinese agricultural machinery products.

**4.1 Analysis of International Market Share (IMS) Index**

International market share (IMS) refers to the share of one country's product in the international market, which is the most intuitive indicator reflecting the overall competitiveness of the product in international market. The formula is specified by equation (1).

$$IMS = \frac{X_{cj}}{X_j} \tag{1}$$

Within equation (1), the IMS index represents the international market share of Chinese agricultural machinery products,  $X_{cj}$  represents the total export volume of Chinese agricultural machinery products, and  $X_j$  represents the total export volume of agricultural machinery products in the world. The magnitude of the IMS index straightforwardly illustrates the international competitiveness of Chinese agricultural machinery products.

Table 3 summarizes the overall and by-product structure international market share of Chinese agricultural machinery products. As revealed by Table 3, the international market share of export of Chinese agricultural machinery products increased from 6.82% in 2017 to 9.17% in 2021, achieved an increment rate of 34.46%. The increased international market share indicates the international competitiveness of Chinese agricultural machinery products demonstrates a positive upward trend. Among various classes of agricultural machinery products, the largest increment is lying on the harvesting machinery products with a growth rate of 43.6%. Planting and fertilization machinery is the only category that has been consistently grown for the past five years. On the other hand, the international market share of agricultural conveying machinery and animal breeding machinery declined year by year, the corresponding international competitiveness is constantly weakening, resulting in a sluggish state. The international market share of agricultural machinery products in other categories, involving ploughing machinery and primary processing machinery, fluctuates in the past five years, but these figures reveal the trend of growth, which indicate the promising potential of international competitiveness.

**Table 3: IMS Index of Various Classes of Exporting Chinese Agricultural Machinery Products**

Types of Agricultural Machinery Products	2017	2018	2019	2020	2021
Harvesting machinery	10.16%	9.78%	11.72%	12.67%	14.59%
Power machinery	2.71%	2.50%	2.83%	3.37%	4.71%
Primary processing machinery	7.65%	7.41%	7.67%	7.79%	9.27%
Ploughing machinery	11.64%	11.96%	10.79%	12.34%	13.77%
Animal breeding machinery	9.65%	6.97%	7.03%	7.41%	7.30%
Planting and fertilization machinery	9.56%	9.65%	10.16%	10.68%	12.31%
Post-harvest processing machinery	15.61%	15.07%	17.34%	18.39%	17.67%
Agricultural conveying machinery	1.31%	0.86%	0.67%	0.62%	0.90%
Other machinery	6.05%	5.53%	5.98%	7.91%	9.35%
TOTAL	6.82%	6.18%	6.79%	7.95%	9.17%

Source: Calculated from UN Comtrade database

**4.2 Analysis of Trade Competitive Advantage (TC) Index**

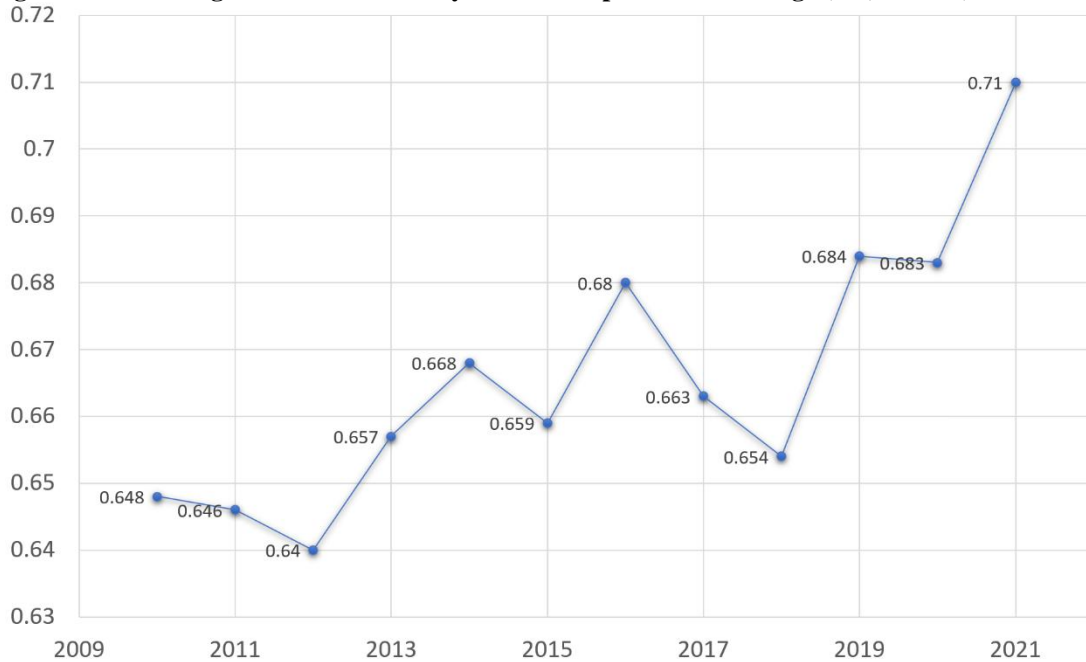
The trade competitive advantage (TC) index refers to the proportion of the difference between the import and export of one certain product over the entire trade volume (including imports and exports) of that particular product. The formula is specified by equation (2).

$$TC = \frac{X_{cj} - M_{cj}}{X_{cj} + M_{cj}} \tag{2}$$

As indicated in (2), trade competitive advantage (TC) index is the main indicator for Chinese agricultural machinery industry enrolled in the foreign trade.  $X_{cj}$  represents the total export volume of Chinese agricultural machinery products, while  $M_{cj}$  specifies the total import volume of agricultural machinery products. The value of TC is in the range of -1 to +1. The index value of -1 represents that China only import agricultural machinery products without any exports to other countries, while the index value of +1 specifies China only export agricultural machinery products to other countries without any import. When the TC close to the value of

+1 simply indicates the international competitiveness of Chinese agricultural machinery products is superior over the products from other regions.

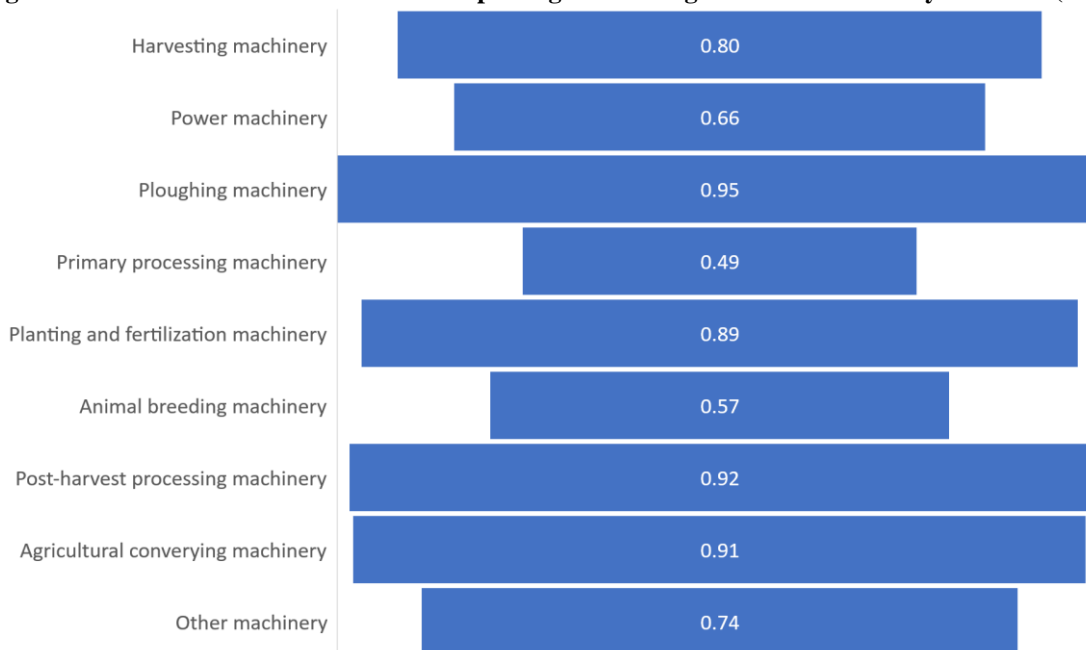
**Figure 4: Chinese Agricultural Machinery Trade Competitive Advantage (TC) Index (2010 to 2021)**



Source: Calculated from UN Comtrade database

From the obtained results as specified in Figure 4, it is possible to observe that the trade competitive advantage (TC) index of Chinese agricultural machinery products maintained above 0.6, which represents the international competitiveness of agricultural machinery export is relatively strong and stable. In addition to that, the same data also reveal the truth that agricultural machinery products are export-oriented, the major reason is lying on the saturated domestic demand for agricultural machinery products. It worth to note that the trade competitive advantage (TC) index firstly broke through the value of 0.7, the exporting business of Chinese agricultural machinery has shown a thriving scene.

**Figure 5: TC Index of Various Classes of Exporting Chinese Agricultural Machinery Products (2021)**



Source: Calculated from UN Comtrade database



By taking year 2021 as one particular example, as specified in Figure 5, for those agricultural machinery products have trade competitive advantage index value above 0.8, it simply indicates that the products in this category normally associated with strong international competitiveness. The products enrolled in this classification involve ploughing machinery (TC = 0.95), post-harvest processing machinery (TC = 0.92), agricultural conveying machinery (TC = 0.91), planting and fertilization machinery (TC = 0.89) and harvesting machinery (TC = 0.80). It is believed that Chinese agricultural machinery enterprises should secure the absolute advantage of these agricultural machinery products via maintaining or even increasing the associated research and development on these products. The primary processing machinery is comparatively inferior in contrast to the above five classes of agricultural machinery products, however, a positive TC value indicate this class of products still has certain international competitiveness and additional financial and political support is required to stimulate its level of competitiveness.

#### **4.3 Analysis of Display Comparative Advantage (RCA) Index**

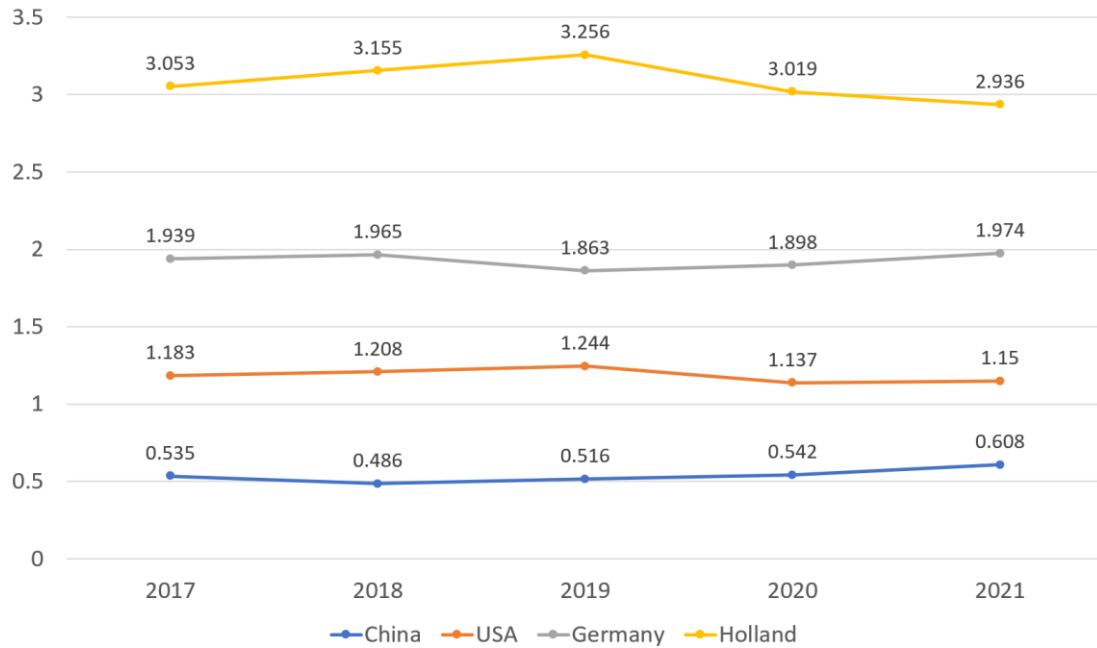
The display comparative advantage (RCA) index was first proposed by Balassa to include economic scale in the competitiveness analysis framework based on the international market share and market penetration index. It was employed to compare the competitiveness of products from different countries in one particular market. The RCA index refers to the relative advantage between one country's export of one particular product and the world's average export volume. The formula is described by equation (3):

$$RCA = \frac{X_{cj}/X_i}{X_{wj}/X} \quad (3)$$

Within equation (3), RCA is the display comparative advantage (RCA) index of Chinese agricultural machinery products,  $X_{cj}$  is the total export volume of Chinese agricultural machinery products,  $X_i$  is the total export volume of all Chinese commodities,  $X_{wj}$  is the total export volume of world's agricultural machinery products, and  $X$  is the total export volume of world's commodities. Suppose the obtained RCA value is greater than or equal to 2.5 (*i.e.*,  $RCA \geq 2.5$ ), it states that the country's products have very strong international competitiveness; else if the obtained RCA value is in the range of 1.25 to 2.5 (*i.e.*,  $1.25 \leq RCA < 2.5$ ), the country's products have reasonably strong international competitiveness; else if the obtained RCA value is in the range of 0.8 to 1.25 (*i.e.*,  $0.8 \leq RCA < 1.25$ ), the country's products have moderate international competitiveness. On contrary, suppose RCA value is less than 0.8 (*i.e.*,  $RCA < 0.8$ ), the country's products competitiveness is weak and normally failed to fulfill the international market demands.

As shown in Figure 6, by comparing the display comparative advantage (RCA) index among China, the United States, Germany, and the Holland from 2017 to 2021, it is possible to discover that Holland has extremely strong international competitiveness for its agricultural machinery products, as its RCA value consistently above 2.5 within the horizon. The RCA value of Germany agricultural machinery products is stably fluctuated around 1.9, that is, within the range of 1.25 to 2.5, and hence, it is believed that the exported Germany agricultural machinery products have reasonably strong international competitiveness. The RCA value of American agricultural machinery products fluctuates between 1.1 and 1.2, which is moderately competitive in the world market as its RCA in the range of 0.8 to 1.25. Lastly, the Chinese agricultural machinery products are relatively backward among the four countries. Although its RCA value has been slowly increasing over the past five years, the value has never exceeded 0.8, indicating weak international competitiveness. Considering that the total export volume of commodities from China always ranked among the top 3 in the world market, the export volume of Chinese agricultural machinery products is overshadowed. Moreover, it is believed that in contrast to the above three matured agricultural machinery industry, there is a long journey for Chinese agricultural machinery industry to go by continuously refining and improving its research and development.

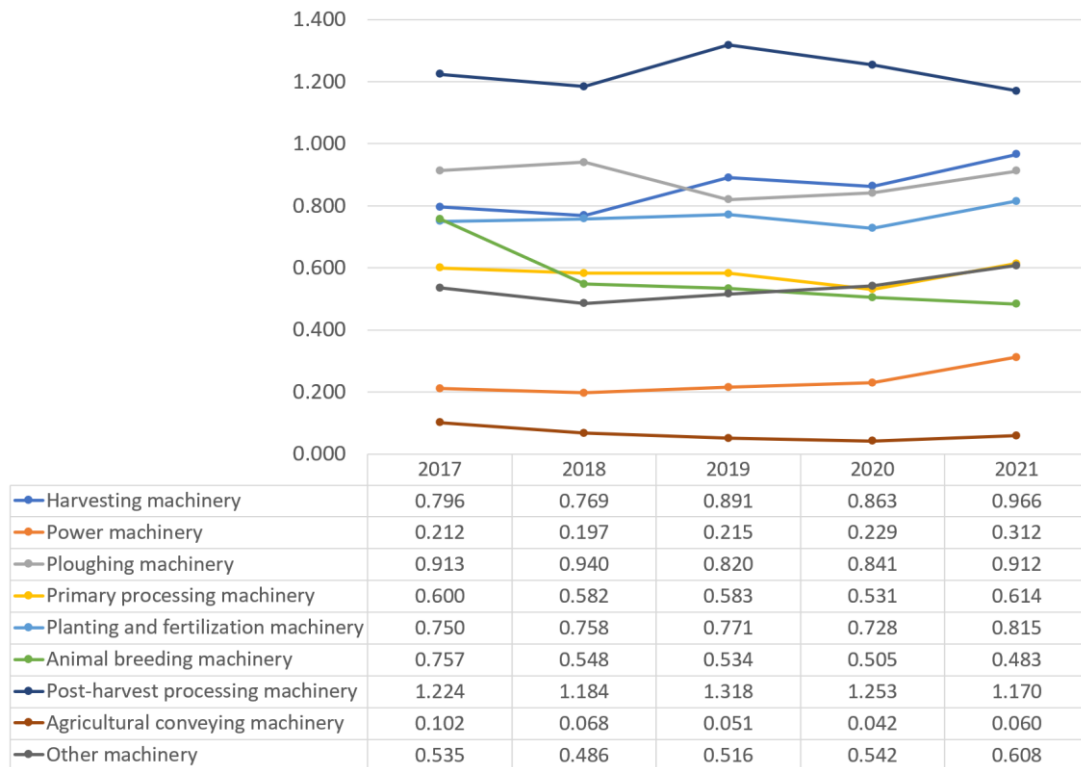
Figure 6: RCA Index for China and Other Agricultural Machinery Exporting Countries (2017 - 2021)



Source: Calculated from UN Comtrade database

Figure 7 lists the corresponding value of RCA indexes of various Chinese agricultural machinery products from 2017 to 2021 for comparison purpose. By observing the Figure 7, it is possible to reach following conclusions: firstly, the post-harvest processing machinery has the strongest international competitiveness among Chinese agricultural machinery product categories over the past five years, its RCA value fluctuates around 1.25, which indicates it has moderate to reasonably strong international competitiveness. The international competitiveness of ploughing machinery and harvesting machinery products are ranked at 2<sup>nd</sup> and 3<sup>rd</sup> place, their corresponding RCA values are in the range of 0.8 to 1.25, which specifies they have moderate international competitiveness. Secondly, the agricultural handling and power machinery product have very weak international competitiveness as their RCA values are lower than 0.4 in the past five years. Lastly, the RCA value of animal breeding machinery products experienced a significant declination from 0.757 in 2017 to 0.483 in 2021, implying the decreasing international competitiveness.

Figure 7: RCAIndex for Various Classes of Exporting Chinese Agricultural Machinery Products (2017-2021)



Source: Calculated from UN Comtrade database

## V. PROBLEMS ASSOCIATED WITH INTERNATIONAL COMPETITIVENESS OF CHINESE AGRICULTURAL MACHINERY PRODUCTS

Despite there are tremendous achievements of Chinese agricultural machinery industry in the past 10 years which is reflected by the increasing international competitiveness, there are still some problems hinder its further development, in this section, we enlisted three major problems associated with the international competitiveness of Chinese agricultural machinery products.

### 5.1 Lack of Product Diversity and Insignificant Competitive Advantage

Majority of Chinese agricultural machinery products are restricted to small and medium-sized machines with relatively similar functions. By 2020, the export of Chinese agricultural machinery and components reached 8.75 billion U.S. dollars. Among these exports, the hosting machines covers 5.78 billion U.S. dollars, achieved an increment of 15.8% in contrast to previous year. Meanwhile, the export of spare parts of agricultural machinery components has declined to less than 2% of the total export volume. This phenomenon indicates the success transformation of the Chinese agricultural machinery industry and the improvement of international competitiveness of agricultural machinery products. However, the major problem which hinder its further development is the lack of product diversity and insignificant competitive advantage. As stated by Yoshida Kishida, the chairman of Japanese Agricultural Machinery Industry Association, the variety of agricultural machinery products manufactured in China have only one-fifth of that manufactured in Japan and South Korea, and there is a tremendous technological gap in contrast to the agricultural machinery manufacturing firms in Europe and North America. The underlying reason is that the agricultural machinery products are very similar in appearance and interior, lacking sufficient product differentiation, which is believed to be a dominant factor affect the international competitiveness of Chinese agricultural machinery products.

Within the major categories of exporting agricultural machinery products, as specified in section 4.3, only the post-harvest processing machinery, ploughing machinery and harvesting machinery products have moderate to reasonably strong international competitive advantage. Moreover, Chinese agricultural machinery manufacturing and exporting enterprises are heavily relying on the price advantage to gain international competitiveness in the past. However, in recent years, the significant increment of raw material prices, rising delivery cost, adverse exchange rate fluctuations and other factors may bring additional financial pressure to these firms. Despite the stable increment in the total export volume of Chinese agricultural machinery products, the revenue for these enterprises is diluted, and hence, they lack sufficient retained earnings to conduct research

and development, diversify the product lines, obtain essential international certifications for agricultural machinery products and upgrade the emission standards. All these factors will encumber the Chinese agricultural machinery products from obtaining competitive advantage over the products from other regions.

### **5.2 Inefficient Coordinated System and Lack of Long-run Strategic Perspective**

With the rapid growth of Chinese agricultural machinery industry, the coordinated development of machinery components providers and service supporting enterprises become crucial on promoting the sustainable growth of the entire industry. Industrial transformation and upgrading, strategic adjustment, quality refinement, and efficiency improvement are also key factors in stimulating the health development of the agricultural machinery industry.

At present stage, majority of Chinese agricultural machinery enterprises are operated like a giant assembling center. Except for certain key components, which are produced by manufacturers with large-scale production capacity, many small components are produced by small enterprises scattered around. The contemporary quality assurance system of agricultural machinery enterprises cannot operate efficiently, and hence, hard to ensure the quality of individual components. In addition to that, majority of the Chinese agricultural machinery product manufacturing and exporting firms are small in scale, and they failed to form an industry cluster with strong professional cooperation and supporting production capabilities. Even when encountered with fierce competition from international competitors, there is still a severe situation of product homogenization among these exporting enterprises.

Moreover, there are certain Chinese agricultural machinery enterprises, in order to boost up their international competitiveness, the only adopted strategy is to suppress the selling price by reducing the production cost, product quality as well as customer services. This tactic may be effective in short-run, as these firms may seize the market opportunities. However, in the long run, not only the revenue of domestic companies will be diluted, and due to terrible product quality and customer services, but also leads to significant declination of products' international reputation.

### **5.3 Limited Exporting Channel and International Brand Awareness**

As stated in previous section, at present stage, majority of the Chinese are belonging to small or medium-sized enterprises with severe shortage of foreign trade talents and terrible international trade channels for enterprises. Some larger agricultural equipment manufacturers have successfully developed mid to high-end technology products, but due to the lack of sufficient understanding towards the foreign markets, and hence, they are failed to obtain the orders from the markets occupied by their competitors.

It is believed that the limited export channel in the international market is closely associated with the low international brand awareness. The restricted international brand awareness of Chinese agricultural machinery products is mainly caused by limited brand operation conducted by the Chinese agricultural machinery enterprises. Conversely, in Dec 2009, the world's third largest agricultural machinery enterprises, the AGCO Group announced the establishment of factories in Heilongjiang and Jiangsu province of China. Since then, many top-tier international agricultural machinery enterprises, including John Deere, New Holland, Kubota, and Yangma, have entered the Chinese market at full scale. These enterprises spent lots of efforts and fundings on brand management and intellectual property protection, as a consequence, they have obtained a significant portion of the international market share. Moreover, due to the existence of vicious price competition, consumers' expectations for product quality and after-sales service have been severely impacted. If this situation continues to develop, the distributors will suffer from huge reputational losses. In summary, domestic agricultural machinery enterprises should not solely rely on the temporary international orders, the export channel construction and appropriate brand management plays a crucial rule on enhancing its international competitiveness.

## **VI. COUNTERMEASURES ON ENHANCING INTERNATIONAL COMPETITIVENESS OF CHINESE AGRICULTURAL MACHINERY PRODUCTS**

### **6.1 Emphasizing on Research and Development to Improve International Competitiveness of Products**

The primary prerequisite for market competition is lying on its product. It is believed that the technological innovation is the foundation for agricultural machinery enterprises. The international competitiveness of Chinese agricultural machinery products, however, is limited by its core technologies. On the opposite site, the technological innovation usually associated with extremely high uncertainties, and enormous efforts are required in the subsequent development, industrialization, and commercialization. In addition, due to the long cycle of technological innovation and high research and development cost, Chinese agricultural machinery enterprises generally lack sufficient driving force for conducting research and development. Moreover, agricultural machinery products belong to a category of mechanical products with high technological

content and long service cycles. Customers are cautious in purchasing agricultural machinery products and require a comprehensive evaluation of various factors involving product quality, value, and after sales service.

However, in the long-run, in order to boost the international competitiveness, agricultural machinery companies need to strengthen their research efforts, achieve major breakthroughs in the research and development of core technologies, including design methodologies, key components, and experimental and testing equipment. The domestic agricultural machinery products manufacturing companies should collaborate with universities and research institutions. Meanwhile, it is essential to improve the technological contents as well as automation level of agricultural machinery products, and promote industrial innovation and technological upgrading and transformation.

At present stage, there are three major tasks for Chinese agricultural machinery enterprises to be accomplished in the near future: firstly, refining the contemporary safety standard of agricultural machinery products that matches the international standards; secondly, improving the reliability of agricultural machinery products; lastly, utilizing energy-saving technology which aims to minimize the adverse effect of technical trade barriers implemented by the importing countries. For the sustainable growth of the agricultural machinery industry, the emphasize is still lying on increasing the corresponding investments in technical research and development, recruiting or training more talents in the research and development work. By doing that, the enterprises may secure more advanced technologies, increasing added value for products, and hence, strengthening their international competitiveness.

### **6.2 Promoting Formation of Strategic Alliances and Leverage the Advantages of Leading Enterprises**

As specified in section 5.2, most of Chinese agricultural machinery enterprises are overly stick onto the short-run profits, making it difficult for them to share their technology and may even rise the vicious competition by constantly suppressing selling prices for their products. The reduced selling prices may simultaneously drive down the product quality as well as after-sales customer services, ultimately leading to the collapse of products' international reputation in the long-run.

In order to improve the international competitiveness of Chinese agricultural machinery products, there should be more technology exchange and cooperation among domestic enterprises. Therefore, it is believed that domestic agricultural machinery enterprises can form strategic alliances under the supervision of the industrial association or regional government agencies. By doing so, these enterprises can exchange their patents and copyrights, share the working experience, pay visits to the workshops with advanced technology. Moreover, the situation of vicious price competition can be completely eliminated, and when any enterprises have encountered with exporting hardship, other enterprises in the same strategic alliance may jointly propose the countermeasures via collaboration. However, the success of the industrial strategic alliance is highly depending on the contribution of the industrial association or regional government agencies.

In addition to that, it is believed that leading enterprises in the agricultural machinery industry should leverage their advantages. In most occasions, leading enterprises in the modern agricultural machinery industry normally associated with strong innovation capabilities and ample fundings. They may not only provide financial and technical support for small enterprises in the same field, but also have sufficient experience on dealing with international markets. As a result, appropriate leverage the advantages of leading enterprises will promote the development of the entire industry and serve as a connection between various domestic small and medium-sized enterprises and international markets. Meanwhile, leading enterprises can also promote technological innovation and share their matured business management experience, and hence, strengthening the overall international competitiveness of Chinese agricultural machinery products.

### **6.3 Establishing After-Sales Services Network, Talent Cultivation, and Brand Strategy**

At present timing, the entire agricultural machinery industry has gradually moved towards specialization. Advanced network technology has opened up a fast channel for exporting enterprises to access the international market. The network can provide timely trading information, match various demands among international market participants, utilize the e-commerce services to reduce the marketing cost, and employ the network to integrate resources. Therefore, in order to maintain or even expand the total export volume of agricultural machinery products, it is crucial to establish a broader sales network and after-sales service system. The international market competition is becoming increasingly fierce, and the after-sales services provided by agricultural machinery enterprises becomes an important factor for potential customers on making purchasing decisions. The top-tier international agricultural machinery enterprises located in Europe and North America have already established matured after-sales service network to ensure the maintainability of their products. On contrary, due to the vicious price competition, majority of the small to medium-sized agricultural machinery enterprises lack of sufficient after-sales service supports. Therefore, for these companies, it is crucial to establish the after-sales servicenetwork, which is employed to ensure the delivered products may at least maximize its



duty within the designated life cycle. By doing so, it is believed the international competitiveness of these products can be improved, and hence, maintaining or even increasing the corresponding export volume.

In order to stimulate the research and development, leading to the upgrading and transformation of the entire industry, cultivating sufficient amount of technical and professional talents plays a vital role. For agricultural machinery enterprises, a comprehensive talent cultivation system should be established to ensure the continuous development and growth of talents. Moreover, the agricultural machinery companies should recruit experienced professionals and managers from top-tier international agricultural machinery enterprises, and assign these experts as the group leaders of various functional teams of research and development. In addition to that, more incentives should be provided to staffs in different teams of research and development to stimulate their working enthusiasm and morale. A comprehensive talent cultivation system is believed to be the best method to promote the sustainable growth of the enterprise and improve the international competitiveness of the products.

In order to become competitive in the international market, continuously refining the manufacturing processes and striving to create first-class products is crucial. However, it is also essential for Chinese agricultural machinery enterprises to improve their brand awareness. It is recommended that the enterprises should learn from the top-tier agricultural machinery brands. Small to medium-sized enterprises should actively participate in various agricultural machinery exhibitions, so that more potential customers can observe their products in close contact. Large agricultural machinery enterprises should actively implement brand strategies, utilize their advanced technology and international sales channels, keep up with international technology trends, and vigorously explore the global market.

## VII. CONCLUSION

This paper is mainly emphasizing on summarizing the current status of Chinese agricultural machinery products in terms of total export volume, export commodities structure, and export market structure. Followed by the calculation of International Market Share (IMS), Trade Competition (TC), as well as Display Comparative Advantage (RCA) indexes. It is possible to determine the underlying problems which are adversely affect international competitiveness of Chinese agricultural machinery products. The most crucial problem is the lack of product diversity and majority of the machinery products do not have sufficient core competitive advantage. It is mainly caused by the absence of coordinated ecosystem in the industry and the enterprises are overly stick onto the short-run profits while ignoring the long-run strategic perspectives. Limited exporting channel and lack of international brand awareness may also detrimentally affect the product's competitiveness. Moreover, this paper also attempted to address the potential countermeasures to tackle these problems. Focusing on research and development will enhance the international competitiveness of agricultural machinery products in the long-run. On the other hand, forming strategic alliances among enterprises with the supervision of government agencies or industrial associations, by doing so, it is possible to leverage the advantages of leading enterprises. Moreover, establishing the after-sales services network to ensure the products maximizing its duty within the designated life cycle, cultivating the talents to accelerate the research and development, adopting appropriate brand strategy are believed to be the methods to enhance the competitiveness of Chinese agricultural machinery products.

Nowadays, the competition in international agricultural machinery market is becoming increasingly fierce, and the global agricultural machinery industry has shifted to the pattern of "large-scale production by large companies and specialized competition by medium-sized companies". It simply states that large-sized international agricultural machinery giants, due to large-scale production, they may secure the global market share by suppressing the associated cost as well as the selling price to strengthen their product competitiveness. For small to medium-sized firms to survive in the global competition, the best strategy can be adopted is lying on specialization, which means the manufactured agricultural machinery products must have core competitive advantage over its major competitors. Therefore, Chinese agricultural machinery industry, which consists of large portion of small to medium-sized manufacturers, need to focus on research and development by establishing comprehensive talent cultivation system, forming strategic alliance with domestic leading enterprises, and increasing the capital injection. The ascending values of IMS, TC and RCA indexes in the past five years suggest the continuous improvement on the international competitiveness of Chinese agricultural machinery products, as long as the enterprises accelerate its integration and collaborative innovation to make up for the shortcomings of technology, it is believed that the international competitiveness of Chinese agricultural machinery products will continue to improve in the future.

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