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Study on the Seed Market in China

By

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and

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Executive summary

This study was carried out by the Sino-German Agricultural Centre (DCZ), a platform jointly financed by the German Federal Ministry of Food and Agriculture (BMEL) and the Chinese Ministry for Agriculture and Rural Affairs (MARA).

The purposes of the study are as follows: to review the Chinese seed industry and market system, analyze the supply and production of seed, estimate the seed demand for major crops, investigate the institutional and policy environment of seed production and the seed trade, identify problems and constraints existing in the Chinese seed market, and make recommendations for promoting Sino-German cooperation in the seed sector.

Due to the outbreak of COVID-19, this study is mainly based on second-hand data, literature review and on-line interviews with relevant Chinese institutions and associations, such as the China National Seed Trade Association (CNSTA) and the China National Seed Association (CNSA). Recommendations for Sino-German seed sector cooperation were developed in consultation with colleagues from the CNSTA and Foreign Economic Cooperation Center, MARA (FECC).

1. Major findings and conclusions

A. Overview of the Chinese seed industry and market

- (1) **China has a very large seed market.** With 1.4 billion people, China is the largest food producer and consumer in the world. Annually, the average area sown with grain is approximately 120 million hectares (ha), and the annual grain production is 650 million tons. To produce this volume of grain, China requires about 25 billion kg of seeds per year.
- (2) **The Chinese seed industry and seed market have developed more rapidly in the past two decades than in any other period.** The Chinese seed industry and seed market have gone through four major stages: (i) From 1949 to 1958, individual farmers cultivated small-scale farmland and there was no seed-breeding system to supply high-quality seeds to farmers; (ii) from 1958 to 1982, during the rural collective period, the people's communes and production brigades set up seed-breeding plots for the production of seeds; (iii) from 1982 to 2000, the government controlled the seed-breeding system and a commercial seed market was not established; (iv) since 2000, as China entered the WTO and China's first Seed Law was published, the Chinese seed market has opened up to international seed companies and the industry has experienced very rapid development. In this period, a large number of seed enterprises have been established, with the development and implementation of regulations, approval procedures and crop seed structure creating a robust policy and regulatory framework for the development of the seed industry in China.
- (3) **Through twenty years of fast development, China has become the world's second-largest seed market.** In 2019, China accounted for 23% of the world seed market. The estimated crop seed market size in China increased from 14.14 billion USD in 2011 to 19.57 billion USD in 2019, with a compound annual growth rate (CAGR) of 4.73%. With the increase in market prices and commercial rates, this equates to average annual growth of about 814 million USD.
- (4) **A large market share of major crop seeds in China.** In 2019, the total market value for crop seeds was about 137 billion Yuan, with hybrid corn seeds accounting for 35.2 billion Yuan, a share of

25.7%, the largest market share among the three major grain crops. Rice seeds (including hybrid and conventional varieties) had a market volume of 20.2 billion Yuan with a share of 14.7%, wheat seeds accounted for 19.6 billion Yuan and a 14.3% market share, potato seeds were valued at 15 billion Yuan with a market share of 10.94%, and soya seeds accounted for 3.2 billion Yuan. Besides these grain seeds, approximately 39 billion Yuan (approx. 28.47% of the market share) was contributed by cash crop seeds and vegetables.

- (5) **The commercial rate of Chinese seeds is still relatively low.** The average commercial rate of grain crop seeds in China is about 70.07%, which is significantly lower than in the USA and in European Countries. Among major crops, the commercial rate (CR) of corn and hybrid rice seeds reached 100%, with no more potential for increase, whilst conventional rice, wheat and soybean seeds have a CR of 71.24%, 76.14% and 70.38%, respectively. As for potato seeds, the CR is about 40% with large potential for this to grow. There remains considerable leeway for growth in the CR of most cash crops on the seed market, such as vegetables, seeds of feedstuff crops, flowers, rapeseed, etc.
- (6) **The Chinese seed market is still fragmented and lacks competitiveness.** In 2018, the concentration ratio (CR10) of the entire crop seed market in China was about 18%. The CR10 for hybrid rice and corn seeds was approximately 30-35% and the CR10 of the wheat seed market was about 20%, all of which are significantly lower than equivalent CR values in the global seed market. This implies that the Chinese seed market has considerable potential for integration through the acquisition and merging of enterprises. Above 90% of the seed market is shared by more than 5000 small and medium-sized seed companies, which have very limited R&D and innovation capacity and suffer from a shortage of funds for R&D, production and marketing.

B. Market share and competitiveness of seed enterprises in China

- (1) **A large number of enterprises compete in the seed market.** Stimulated by preferential seed market policies and increasing seed market access, the number of Chinese seed enterprises has expanded rapidly over the past ten years. Until 2019, there were 5000 seed companies in the Chinese market, of which about 98% are small and medium-sized enterprises with very low R&D capacity and a very small market share. Such market structures lead to disorderly and vicious market competition, homogenization of seed varieties and a large surplus of seed production, particularly of rice and corn seeds.
- (2) **Dynamic mergers on the global seed market and challenges to Chinese seed companies.** Some Chinese seed companies, such as Longping Hi-Tech, China National Seeds Group Co., Ltd, Denghai Seed, Dunhuang Seeds and Win-All Seed (Quanyin) stand out from competitors by acquiring small seed-breeding enterprises and relevant input-manufacturing and service companies. However, their R&D and financial investment capacity and market shares are still significantly lower compared to large international seed companies. In 2018, the top 50 Chinese seed companies occupied about 37% of the domestic crop seed market, while international large seed companies like DuPont+Pioneer (USA), Bayer/Monsanto (Germany), KWS (Germany) and Limagrain (French) occupy and control about 70% of the world's seed market, including the Chinese market. The power of such multinational corporations is built through regular mergers and joint acquisitions.
- (3) **Opportunities for the integration of the Chinese seed market.** Given the high number of seed

enterprises and limited market competitiveness, there exists an urgent need and great potential to integrate the fragmented Chinese seed market through mergers and acquisitions. This opportunity is open to international as well as domestic corporations.

B. Assessment of Chinese seed production, supply, and demand

- (1) **Large surpluses of hybrid rice seed.** From 2013 to 2016, the annual surplus of hybrid rice seeds declined from 130 million kg to 80 million kg, while from 2016 to 2019, the surplus increased from 80 million kg to 160 million kg. Overall, the large surplus equates to between 1/3 and 2/3 of annual domestic demand. To absorb this surplus, Chinese enterprises began to develop an export market in South and Southeast Asian countries.
- (2) **Overproduction and supply of hybrid corn seeds.** The surplus of hybrid corn seeds in China is much larger than that of hybrid rice seeds. In 2013 and 2014, the surplus reached 1 billion kg, a figure almost as great as annual domestic demand. Even in 2016, the year with the highest corn planting area, the seed surplus amounted to more than 500 million kg. Such a large surplus in annual seed supply generated high levels of competition between different seed breeding enterprises and affected the profits of these companies.
- (3) **The gap between wheat seed supply and demand.** The commercial rate of wheat seeds in China is between 70 and 80%, leaving a market potential of 20-30%. The estimated gap for commercial wheat seeds is about 110 million kg/year. Most wheat seeds are conventional varieties, allowing farmers and wheat growers to select and produce seeds themselves. However, high-yield and high-quality commercial wheat seeds would further increase the productivity and marginal profits of wheat growers. In addition, there is also a market demand for particular varieties, such as bakery wheat, which are required by certain consumers and niche markets.
- (4) **The supply and demand of vegetable seeds.** China is the largest vegetable producer and consumer in the world. The sown area of vegetables remains at 24 million ha and the gap between seed supply and demand is about 5000 to 6000 tons, which is bridged via imports from the USA, Korea, The Netherlands and Japan. In 2018, China imported 8709 tons of vegetable seeds from these countries, with a total trade value of 228 million USD.

C. Institutions and regulations related to the seed market

- (1) **Institutions were developed to regulate rapid growth in the seed market.** In the past twenty years, China has developed effective governmental and non-governmental systems and a comprehensive regulatory framework to facilitate rapid development of the domestic and international seed market.
- (2) **Governmental authorities.** The Department of Seed Industry at MARA and NATESC are two important governmental stakeholders contributing to policy development, a regulatory framework, and the testing and approval of new plant varieties.
- (3) **Seed associations.** CNSA and CNSTA are two seed market and trade-related NPOs, supervised by NATESC and MARA. These two organizations play important roles in domestic and international seed market development, and will facilitate Sino-German cooperation in the seed sector;

- (4) **A regulatory framework for seed sector development.** China has already set up an effective legal and regulatory framework to guarantee the smooth development of a domestic seed market and international trade.

2 Recommendations for Sino-German cooperation in the seed sector

Based on the findings, the research team made the following recommendations to strengthen Sino-German cooperation in the seed sector:

- (1) **Facilitate Sino-German dialogue on seed sector policy.** Dialogue on seed sector policy will be incorporated into the DCZ Agricultural Policy Dialogue Platform. The invitation to participate is extended to Chinese seed sector-related governmental authorities and agencies, as well as seed associations, such as the Department of Seed Industry, NATESC, and other relevant departments of MARA, CNSA, CNSTA, the German Federal Plant Variety Office (Bundessortenamt,-BSA), relevant departments and agencies under BMEL, the German Seed Alliance, the German Plant Breeders' Association (Bundesverband Deutscher Pflanzenzüchter,-BDP), and German Export Association for Food and Agriproducts (GEFA). These stakeholders will be invited to join the policy dialogues which will be held in Sino-German Agribusiness Conference and Sino-German Agriculture Week. Thematic topics for the policy dialogues will be proposed and agreed by partners based on mutual interests. These topics are likely to include a policy framework for plant variety property rights protection; International, Chinese and German rules for the seed variety trade; a policy and regulatory framework for conservation and effective use of plant gene resources; protection and conservation of plant biodiversity; a focus on the legal system in China, Germany and other EU countries for the approval and registration of new seed varieties.
- (2) **Carry out Sino-German seed business dialogue.** Sino-German seed business dialogue is encouraged to form part of the DCZ Agribusiness Dialogue Platform. This will be incorporated into the Sino-German Agribusiness Conference and Sino-German Agricultural Week. Chinese and German companies operating within the sector (i.e., CNSA and CNSTA, the German Seed Alliance, the German Plant Breeders' Association (Bundesverband Deutscher Pflanzenzüchter-BDP), and the German Export Association for Food and Agriproducts (GEFA), will be invited to attend the dialogues. Thematic topics of the business dialogues will be proposed and agreed by CNSTA and BDP and confirmed with DCZ prior to the events. The seed business dialogue will also serve as a platform to strengthen partnerships between Chinese and German seed companies
- (3) **Strengthen Sino-German technical and scientific cooperation in the seed sector.** It is recommended to create a platform for Sino-German technical and scientific cooperation within the seed sector. Chinese plant-breeding institutions, such as the Plant Breeding Institute of CAAS, the Plant Breeding Institute of Chinese Academy of Sciences (CAS), Faculties of Plant Breeding in Agricultural Universities, and similar German institutions, such as the Society for Plant Breeding (Gesellschaft für Pflanzenzüchtung e.V.- GPZ), the Max Planck Institute for Plant Breeding Research (Max Planck Institut für Pflanzenzüchtungsforschung – MPIPZ), the Leibniz Institute of Plant Genetics and Crop Plant Research (Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung- IPK), the Julius Kühn Institute Federal Research Centre for Cultivated Plants (Julius Kühn-Institut Bundesforschungsinstitut für Kulturpflanzen- JKI), etc., will be invited to join the platform. Thematic cooperation areas could focus on hybrid breeding technology;

technology for the conservation of genetic resources; plant biodiversity and the exchange of genetic breeding materials; technical standards and procedures for the approval of new varieties; and a technical and procedural toolkit for arbitrating the infringement of plant varieties.

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List of Abbreviations

BDP	German Plant Breeders' Association (Bundesverband Deutscher Pflanzenzüchter)
BSA	Federal Plant Variety Office (Bundessortenamt)
BMEL	Federal Ministry of Food and Agriculture (Bundesministerium für Ernährung und Landwirtschaft)
CAAS	Chinese Academy of Agricultural Sciences
CAGR	Compound annual growth rate
CNSA	China National Seed Association
CNSG	China National Seed Group
CNSTA	China National Seed Trade Association
CR	Concentration Ratio of Market
DCZ	Deutsch-Chinesisches Agrarzentrum (Sino-German Agricultural Centre)
DSI	Department of Seed Industry, MARA
EDV	Essential derived variety
EU	European Union
FAO	Food and Agriculture Organization of United Nations
FECC	Foreign Economic Cooperation Center, MARA
GAC	General Administration of Customs, China
GAA	German Agribusiness Alliance
GEFA	German Export Association for Food and Agriproducts
GPZ	Society for Plant Breeding (Gesellschaft für Pflanzenzüchtung e.V.)
IPK	Leibniz Institute of Plant Genetics and Crop Plant Research (Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung)
JKI	Julius Kühn-Institute, Federal Research Centre for Cultivated Plants (Julius Kühn-Institut, Bundesforschungsinstitut für Kulturpflanzen)
M&A	Merge and Acquisition (of Enterprises)
MARA	Ministry of Agriculture and Rural Affairs, China
MPIPZ	Max Planck Institute for Plant Breeding Research (Max Planck Institut für Pflanzenzüchtungsforschung)
NBS	National Bureau of Statistics, China
NATESC	National Agricultural Technical Extension and Service Centre
R&D	Research and Development
yoy	Year-on-Year increase (%)

Unit conversion:

Land Area: 1 *ha*=15 Chinese *mu*; 1 Chinese *mu*=0.067 *ha*

Currency: 1 Euro=7.7 RMB (CNY); 1 CNY=0.129 Euro

1 USD=7.0 RMB (CNY); 1 CNY=0.143 USD

1. Introduction

1.1 Background to the study

China is the largest seed consumer and the second largest seed producer in the world. As the Chinese government increasingly stresses the importance of national food security, seed production and market supply gains strategic importance in the crop production of the country. Since 2014, the Chinese government has launched the Agricultural Supply-Side Reform and the Ministry of Agriculture and Rural Affairs (MARA) has promulgated a number of regulations and guidelines to regulate the seed sector, seed market and international seed trade.

Sino-German cooperation in the seed sector is an important aspect of cooperation between the two countries in the agricultural sector. In April 2018, the Sino-German Agricultural Centre (DCZ) entered its second phase: in July 2018, the DCZ was invited to participate in the Sino-German Seed Sector Cooperation Workshop. A representative from the China National Seed Trade Association was invited to the DCZ Agribusiness Conference and Sino-German Agricultural Week in 2018 and 2019. As the DCZ project enters its 3rd year of implementation, the BMEL requested the DCZ team to carry out an analysis of the Chinese seed market.

1.2 Study objectives

The primary objective of the study was to review the Chinese seed industry in order to make recommendations to improve the market structure and promote Sino-German cooperation in the sector. To this purpose, seed production, supply and demand in the Chinese market were analyzed. The institutional and policy environment of seed production and trade were then assessed, along with problems and constraints existing in the Chinese seed market.

1.3 Methodology

Due to the outbreak of COVID-19, the study team could not conduct face-to-face interviews with stakeholders. Instead, the following methods and tools were used to collect relevant data and information:

- (1) Literature review and secondary data analysis. The sectoral data were mainly collected from relevant research reports and industry research webpages.
- (2) Telephone interviews or WeChat interviews were carried out to validate this data. The interviews also facilitated the collection of feedback and comments from relevant stakeholders, such as the China National Seed Trade Association (CNSTA), and relevant divisions of the Department of Seed Administration, MARA.
- (3) Data collection from webpages of seed enterprises and seed associations in China and in Germany.
 - a) China National Seed Association: <http://www.seedchina.com.cn>;
 - b) MARA Department of Seed Industry: <http://www.zzj.moa.gov.cn>;
 - c) China Seed Information Network: <http://www.yhtongxun.com/zhongyexinwen/>

- d) National Agricultural Technology Extension and Service Centre (NATSC): <https://www.natesc.org.cn>
- e) China National Seed Trade Association: <http://www.cnstaseed.org>
- f) International Seed Federation (ISF): <https://www.worldseed.org>
- g) The International Union for the Protection of New Varieties of Plants (UPOV): <https://www.upov.int/portal/index.html.en>
- h) International Seed Testing Association (ISTA): <https://www.seedtest.org/en/home.html>

1.4 The Study Team

DCZ formed a task force to conduct the market analysis:

- (1) Prof. Yonggong Liu, DCZ Advisor for Agribusiness Cooperation, took the lead in designing, carrying out and authoring the study. He designed the study concept, collected relevant data and seed market study reports, analyzed the data and wrote up the study report.
- (2) Dr. Feng Ba, a short-term consultant recruited by DCZ, assisted Prof. Liu in collecting and processing data and information. She also wrote up Chapter 5 on institutions and regulations related to the seed market and trade.

2. An overview of the seed industry in China

2.1 Overview of grain and crop production in China

Traditional Chinese proverbs advise that “to the people, food is heaven”, whereas “hunger breeds discontentment”. Securing food production and supply in order to hold the “rice bowl” in their own hands has always been the number one national development goal of China. With a population of about 1.4 billion, China is the largest grain producer and consumer in the world, with the largest seed market. From 2010 to 2019, the average annual sown area of main grain crops (rice, wheat and corn) in the country was 116 million ha, varying from 111.6 million to 119.2 million ha. The sown area of grain crops in 2019 was about 116.06 million ha, an approximate decline of 0.8% compared to 2018. Average annual grain production reached 633.43 million tons in this year. Grain production in 2019 was 663.84 million tons, the highest since 2010, rising by 0.9% compared to 2018 (see Figure 1 and Figure 2).

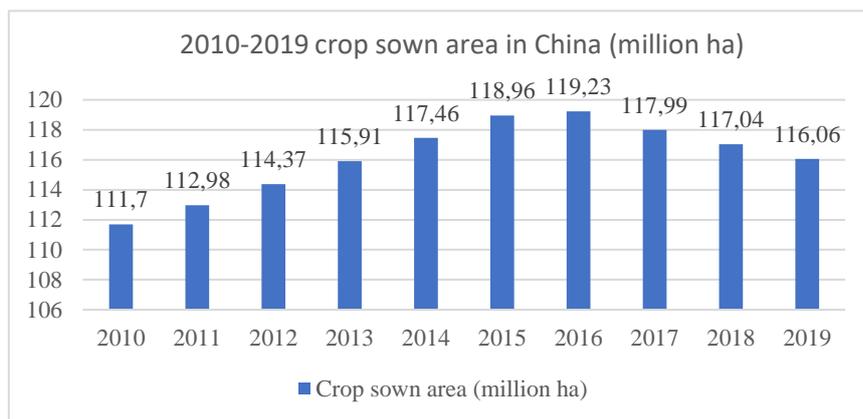


Figure 1: Land area of sown crops in China from 2010 to 2019
 Source: Website of Chinese Industrial Information

With this large production capacity, China has secured self-sufficiency in its national grain crop at an average rate of 95%.

However, in the past decade, China has become the largest soybean importer in the world. Although the sown area and total production of soybean increased by 8 and 10 % respectively

between 2017 and 2019, the total production of soybean reached 18.1 million tons and the self-sufficiency rate was only 15%. In 2019, China imported about 88.51 million tons of soybean from the USA, Brazil and Argentina.

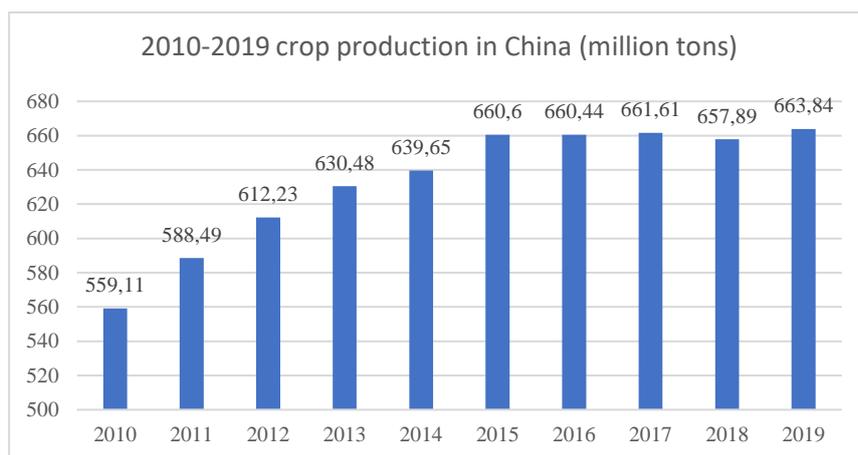


Figure 2: 2010-2019 grain crop production in China
 source: website of China Industrial Information

The estimated annual crop seed demand in China is about 12.5 billion kg, of which the commercial seeds constitute about 50-60%. Given the fact that China has the largest population in the world and very limited per capita arable land resources, food security in China, particularly its self-sufficiency in grain crops, has been made a top

priority of the country’s national development strategy. To guarantee sufficient national food production and supply, the national government of China established a “grain bag” and “vegetable basket” system by specifying targets for the minimum crop-sown area and minimum stock number of major livestock to provincial and county governors.

Considerable national demand coupled with limited arable land and natural resources has forced China to secure grain production by adopting modern agricultural technologies, including (but not limited to) the breeding and supply of high-quality seeds. In this context, a modern seed industry and a well-structured seed market system are important foundations for national food security.

2.1.1 The seed industry in China

A brief overview of the seed sector development in China

In the past 70 years, since the founding of the People's Republic of China, the Chinese crop seed production and supply system has undergone four major stages of development:

- (1) **1949-1958:** Chinese agriculture during this period was based on small-scale and individual farmers' production systems. Both seed selection and production mainly relied on farmers themselves.
- (2) **1958-1982:** During the period of the rural collective system, seed selection and breeding primarily depended on people's communes and production teams. The governmental extension service and breeding research institutions provided technical support to the production team in crop-breeding experiments.
- (3) **1982-2000:** Following rural land reform under governmental administration, a unified seed production and supply system was developed in the country. However, in the late 1990s, during the reform of the national economic system, the seed sector was gradually marketised by the government. During this period of overall market liberalization in the country, most large international seed companies opened representative offices in China and entered the Chinese seed market.
- (4) **Post-2000:** China started to build a modern seed industry system as it constructed a socialist market economy. A market-oriented and fully commercialized seed production and supply system was established in the country. During this period, an open seed-market system was gradually established and operationalized. In 2014, a new seed variety approval system was introduced in response to demands for seed market development. Besides the former approval requirement based on unified experiments conducted by National Agricultural Technical Extension and Service Centre (NATESC), Green Channel was introduced to allow large seed companies with comprehensive capacities of Seed R&D and extension trials to apply for new seed variety approval, based on their own integrated experiments.

The rapid development of the Chinese seed industry in recent decades

China is the second-largest seed production market in the world after the USA. According to the data analysis, from 2006 to 2019 the compound annual growth rate (CAGR) of seed production and supply in China was between 9.0 and 9.5%, which is much higher than the annual growth rate of the demand side during the same period. The rapid growth in seed production and supply caused an overall surplus of major crop seeds, such as hybrid rice and corn seeds.

In the entire agricultural value chain, the seed industry is classified as an input supply market and was driven by seed market demand, i.e., crop production. Since 2000, the Chinese government has attached strategic importance to the development of the crop seed industry. According to one Ministry of Agriculture and Rural Affairs (MARA) estimate, the seed industry contributes about 43% to the production of grain crops and therefore makes a considerable contribution to national food security. In the past two decades, the Chinese seed industry has experienced very rapid growth, both in terms of market volume and the number of seed breeders and suppliers. As Figure 3 shows, the

estimated annual market size¹ of the Chinese seed industry in China continuously increased from 99 Billion Yuan in 2011 to 137 billion Yuan (19.5 billion USD) in 2019, with a CAGR of 4.73%, and an average annual increase in value of 5.7 billion Yuan. According to predictions of the Industrial Information Institute, the seed market value in 2020 will reach 150 billion Yuan (21.4 Billion USD [see Figure 3]).

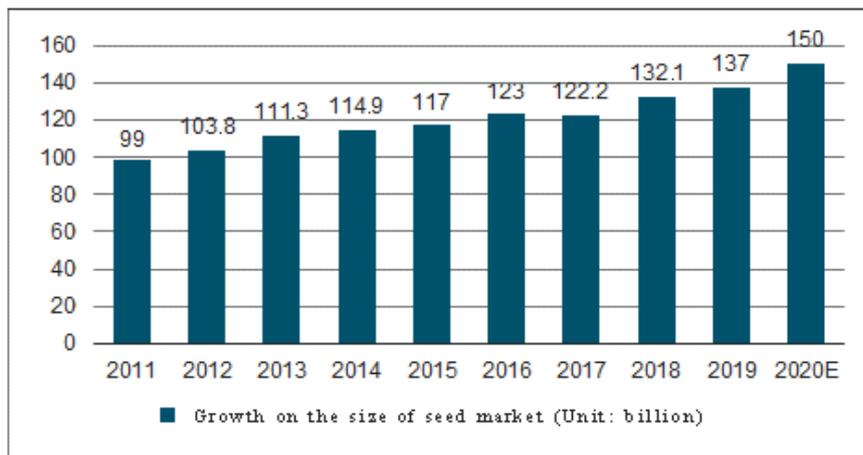


Figure 3: Growth of the size of China's seed market between 2011 and 2020
Source: Website of China Industrial Information

Promoted by the governmental seed industry development policy, the number of registered and approved varieties of hybrid rice and corn seeds increased approximately tenfold from 2010 to 2019. As shown in Figure 4, brisk growth in approved varieties occurred in 2017, 2018 and 2019. In 2019 alone, 372 rice varieties and 548 corn varieties were approved and licensed by the Ministry of Agriculture and Rural Affairs (see Figure 4).

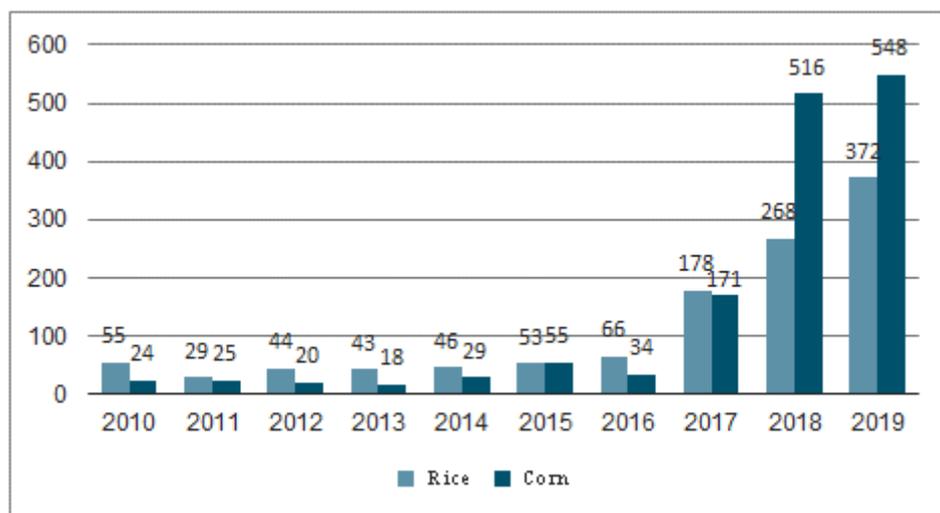


Figure 4: Number of varieties approved by the National Government
Source: Website of China Industrial Information

¹Seed Market Size = \sum (crop sown area(ha) × unit seed demand(kg/ha) × seed commercial rate (%) × seed unit price(yuan/kg)), where seed price is calculated based on grain price x ratio seed: grain

Major problems in the fast-developing seed market

On one hand, the fast-increasing number of approved varieties accelerated the cycle of updating and replacing old varieties of seed, boosting investment in the seed industry; on the other hand, a large number of newly approved crop varieties results in a serious variety homogenization, high market competition and a surplus of major crop seeds. Fierce market competition has impacted the price of seeds and consequently reduced the profits of seed companies.

The market share of major crop seeds in China

In 2019, as shown in Figure 3, the total crop seed market volume was about 137 billion Yuan, out of which the share of hybrid corn seeds reached 35.2 billion Yuan, with a share of 25.7%, the largest market share among the three major grain crops. For rice seeds (including hybrid and conventional varieties) the market volume was 20.2 billion Yuan with a market share of 14.7%, wheat seeds accounted for 19.6 billion Yuan with a 14.3% market share, potato seeds reached 15 billion Yuan with a market share of 10.94%, and soya seeds only made 3.2 billion Yuan, a share of only 2.34% of the entire market. Besides these grain crop seeds, about 39.0 billion Yuan (approx. 28.47% market share) was contributed by cash crop seeds, such as vegetables, oil crops, trees, other cash crops and fodder seeds (see Figure 5, below).

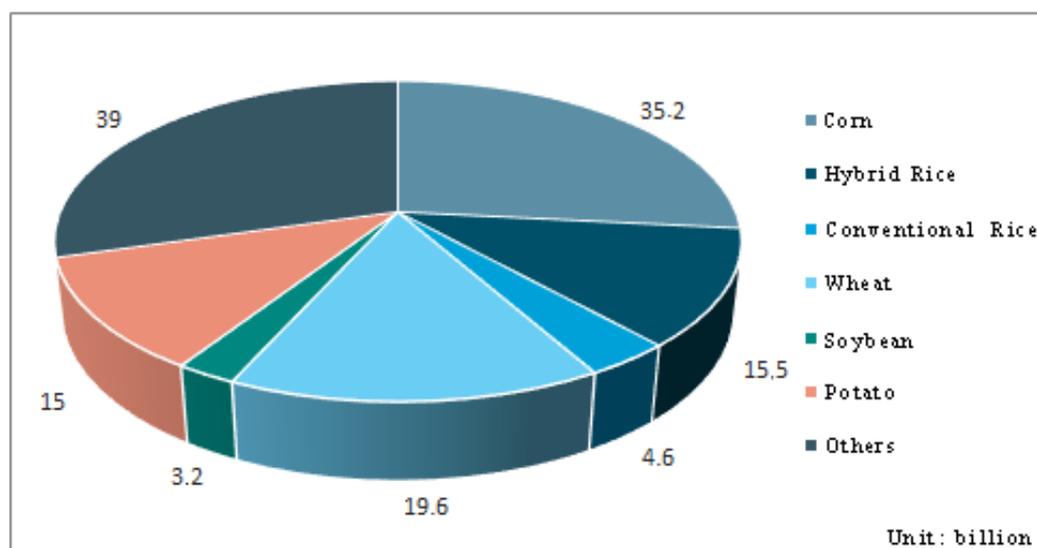


Figure 5: The seed market size of China in 2018
 Source: Website of China Industrial Information

The commercial rate of major crop seeds in China

Despite the rapid development of the seed industry in China, the average commercial rate of crop seeds is significantly lower than in the USA or EU countries.

According to estimates made by the Industrial Research Academy, the average commercial rate of grain crop seeds in China is about 70.07%, which is significantly lower than in the USA and European countries. Among the major crops, the commercial rate of corn and hybrid rice seeds reached 100% with no further potential for increase, whilst conventional rice, wheat and soybean seeds had a

commercial rate of 71.24%, 76.14% and 70.38%, respectively. Potato seed had a CR of about 40%, indicating its large potential for expansion (see Figure 6 below).

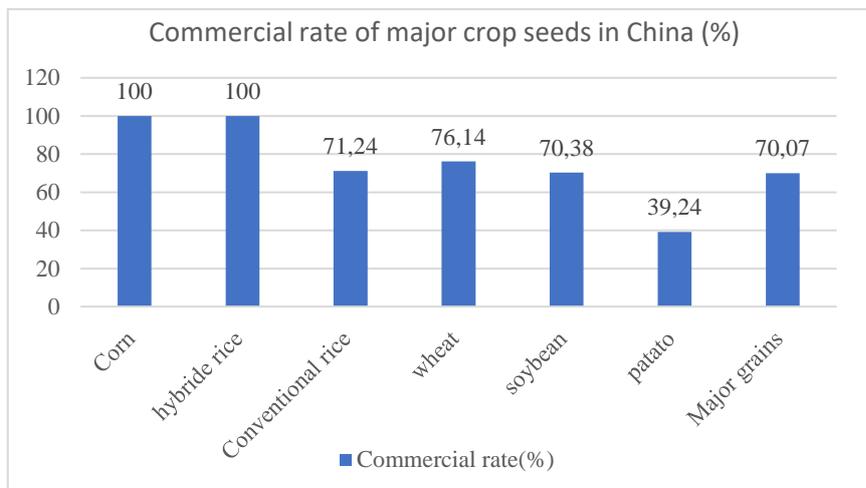


Figure 6: The Commercial Rate of major crop seeds in China
 source: Website of China Industrial Information

In conclusion, for the Chinese crop seed market overall there is still a 30% potential for further commercial exploitation. However, for the hybrid corn and rice seed market, there is no more potential to expand, whereas considerable potential remains for updating seed varieties and expanding the annual sown areas of corn and rice. Furthermore, for

conventional varieties of soybeans, potatoes and cash crops, the commercial rates still have considerable potential to increase.

2.2 The share of Chinese crop seed production in the world market

The market share of Chinese crop seeds in the global market is still relatively low

From 1999 to 2018, the world commercial seed market experienced swift development, particularly from 2006 to 2014, when annual market growth was above 10%, while the total market size in terms of the USD doubled, increasing from two to four billion (see Figure7).

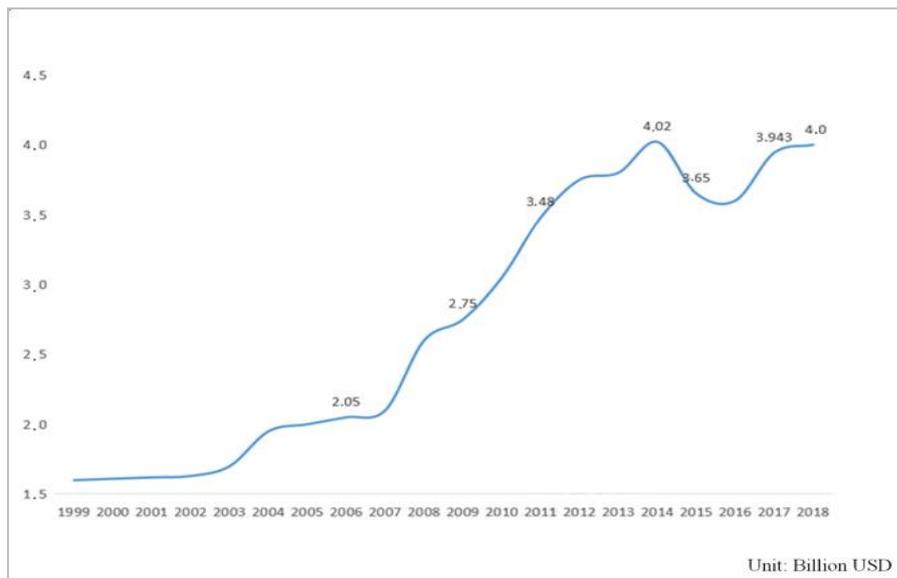


Figure 7: Estimated global seed market value from 1999 to 2018
 source: Qianzhan Industry Research Academy

In 2017, the estimated world seed market size was about 38.7 billion USD. From 2007 to 2017, the ten-year compound annual growth rate (CAGR10) of the global seed market was approximately 6.1%, while the five-year CAGR was about 1.4%. In 2018, the size of the global commercial seed market was about 40.0 billion USD (Qianzhan Industry Research

Academy, 2019).

China, as the largest grain producer with the largest sown area (24% of the global grain production), has a global market share of about 23% and is ranked as the second-largest seed market in the world.

As the second-largest grain producer (approx. 19% of global grain production) and the largest grain exporter in 2018, the USA holds a share of 35% in the global seed market, 12% higher than China. Compared with the USA and other developed countries, China’s seed market share is relatively low (Qianzhan Industry Research Academy, 2019; FAO, 2019). The other six countries with a significant share in the crop seed market include France, Brazil, Canada, India, Japan and Germany. See Figure 8 for the seed market share by country in 2018.

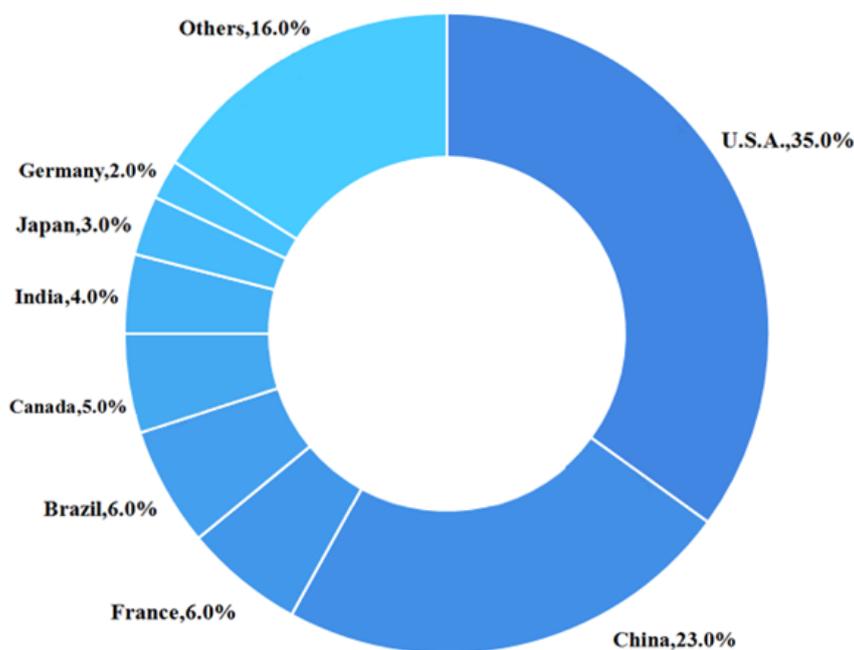


Figure 8: Distribution of Global Seed Market Share
 Source: Qianzhan Industry Research Academy, 2019

The lower competitiveness of the Chinese seed industry in the global market

The overall, relative competitiveness of the Chinese seed industry in terms of basic research, R&D, seed production, processing technologies and commercial marketing, remains low. The marketization of the sector began relatively late: in 2010, MARA promulgated the new seed law and in 2014, it opened up the new seed variety approval control system, enabling large seed-production enterprises with adequate R&D and marketing capacity to test their new varieties themselves. This move greatly promoted the development of the seed market. Meantime, the number of small seed-production enterprises rapidly increased. As Figure 11 demonstrates, about 5000-6000 seed companies entered the seed industry and the seed market between 2010 and 2018, indicating high levels of market competition among small and medium-sized seed enterprises.

Concurrently, the global seed market entered its third stage of integration. Large seed companies and enterprises started quick mergers and acquisitions (M&A) and further enlarged their overall production capacity, increasing their market competitiveness. Figure 9 below illustrates the global seed-market concentration ratio (CR) after the merger of Monsanto with Bayer and Dupont with Dow AgroSciences LLC. Further increases in the market concentration ratio cause ever-higher competition pressures to be exerted on Chinese seed enterprises.

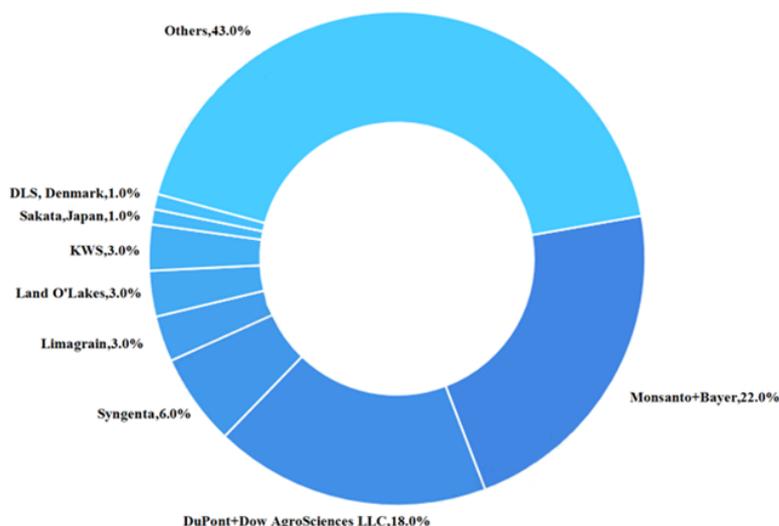


Figure 9: Competition situation of global seed enterprises
 Source: Qianzhan Industry Research Academy, 2019

The lower seed market concentration ratio in China

Concentration ratio (CR) is an indicator of the degree of market monopolization or oligopolistic dominance. CRs are generally used to assess the extent of market control of the largest firms in the industry and to illustrate the degree to which an industry is monopolized or oligopolistic. The most common concentration ratios are the CR₄ and the CR₈, which stand for the market share of the four and the eight largest firms. Inter-enterprise merging and acquisition will increase the market share and control of individual enterprises. The lower the CR, the higher the competition among those enterprises that produce and sell the same products.

From 2010 to 2018 the global CR₃ increased from 51.62% to 58.13% through rapid mergers of similarly powerful companies and acquisitions of smaller competitors. The Seed Market CR in most developed countries underwent similar processes.

In the same period, China has developed an emerging seed market with many small and medium-sized enterprises participating in the market system. The large number of stakeholders and market participants resulted in a low market concentration ratio and therefore affected the national market’s competitiveness in the global seed market. According to Qianzhan Industry Research Academy, in 2018 the overall crop seed CR₁₀ (Concentration ratio calculated based on the market share of the Top 10 crop seed enterprises) of the Chinese seed market was only about 18 %, with the highest CR₁₀ of hybrid rice only reaching only 37.8%. However, the CR₁₀ of hybrid corn seeds was at a much lower level of 18% (see Figure 10). In 2017, the CR₅ of all grain crop seeds in China was only about 8%, only reaching this figure thanks to the CR₅ of the hybrid rice and corn seed enterprises. Overall, the top fifty seed companies achieved only about 30% of the total market share. In conclusion, the grain crop seed CR in China is much lower than the CRs of the USA and other large seed-producing countries. Figure 10 illustrates the CR₁₀ of major crops in China.

The small, scattered and fragmented national seed market restricts competitiveness, and most small and medium-sized enterprises are facing the challenges of market pressure, shortage of investment funds, lack of R&D and marketing capacities, and lower profit margins.

To cope with these challenges from the global and domestic seed markets and strengthen the sector’s competitiveness and effectiveness, it is recommended to reintegrate the Chinese seed market following the rapid expansion of the previous ten years. The following countermeasures are recommended to achieve reintegration of the Chinese seed market system:

- (1) Optimizing the market stakeholder structure through building enterprise groups and corporations.
- (2) Supporting large seed enterprises to lead the industry’s value chain by merging with other stakeholders and actors in the chain, such as input-manufacturing companies, seed processing and marketing agencies, etc.
- (3) Directing financial investment to the breeding R&D sections of companies with the aim of promoting the competitiveness of large Chinese enterprises.

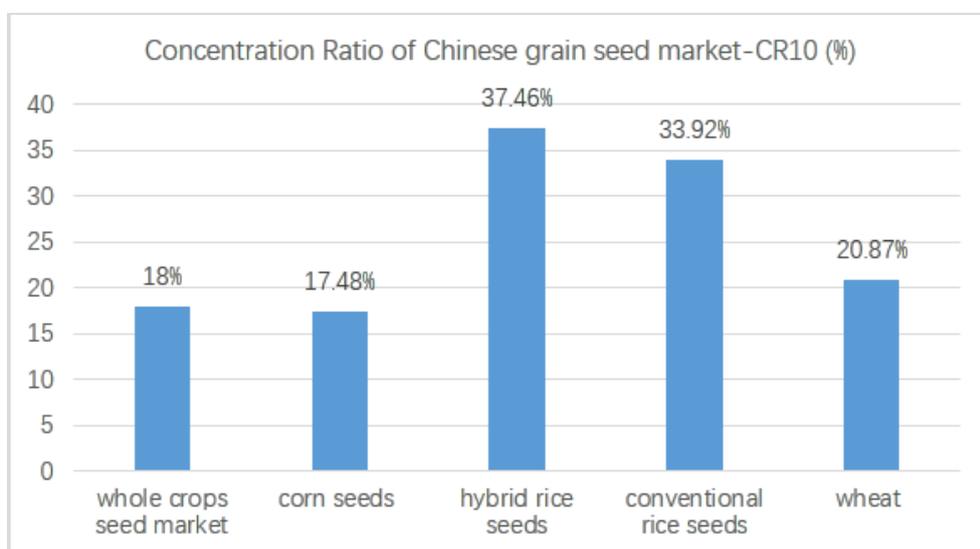


Figure 10: CR10 of major crop seeds in China in 2018
 Source: Website of Industrial Information; Zhiyan Industrial Consulting Institute

The market share of Chinese vegetable-seed companies

There are large numbers of small and medium-scale vegetable seed breeders in China: Longping Hi-Tech Co., Ltd and Lvheng Hi-Tech Co., Ltd are the two main breeders; other companies such as Linong Seeds Co., Ltd, Jianghuai Horticulture Co., Ltd, Quanyin Hi-Tech., Co., Ltd, Chenghai Seeds Co., Ltd have limited market share and modern seed-breeding capacities. Their capacity of all these companies to develop and produce new varieties competitively is rather low.

Compared to large, vegetable seed companies, like Monsanto, Syngenta, Limagrain and RijkZwaan, Chinese seed enterprises have lower Research and Development (R&D) investment capacities. The R&D investment of international seed breeders accounts for 10-12% of their annual revenue, whilst Chinese seed-breeding companies have only a maximum of 2-5% of their revenue invested in R&D. This shortage of R&D funds remains a major constraint on Chinese vegetable seed breeders.

From Figure 14, it can be seen that the market shares of major Chinese vegetable seed producers are very low. Longping Hi-Tech, as the largest vegetable seed producer in China, has only 1.57% market share, with the remaining 6 companies all below 1.0%. This means more than 90% of the vegetable seed market in China is either occupied by large international conglomerates like Monsanto or Syngenta, or by the many small and medium-sized vegetable seed producers. This results in fierce market competition for most Chinese vegetable seed companies. The segmented vegetable market needs to be merged, step by step.

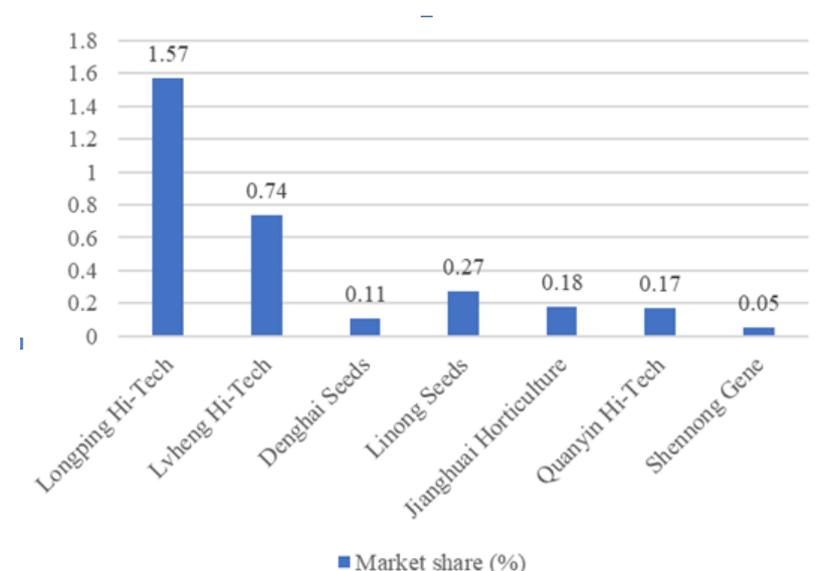


Figure 11 The market share of major vegetable seed companies in China (2017)
Source: Zhiyan Industry Consulting Institute

3. Seed producers and breeders and their market share

3.1 A Large number of seed enterprises in the Chinese seed market

Boosted by government policy, large numbers of seed production and marketing enterprises were established on the market. In 2010, the number of such enterprises in China had reached 8700, reducing to 3900 in 2016. Stimulated by the new regulatory and approval procedures, this number increased again to 4000-5000 in 2017-18 (see Figure 11). However, the fast-growing number of seed enterprises and stakeholders in the Chinese seed market has resulted in unregulated market competition. Currently, the Chinese seed market is still experiencing the dynamic change from market expansion to integration.

Investigations carried out by the Qianzhan Industry Research Academy and Zhiyan Industry Consulting Network indicate that among 5000 seed enterprises in China in 2018, small enterprises with capital resources of less than 100 million Chinese Yuan (less than 14 million USD) account for more than 98% of the market. Less than 2% of seed enterprises have financial capital of between 100 million and 500 million CNY. There are no large enterprises with capital of more than 500 million CNY (70 million USD). The registered capital volume of major Chinese seed companies is much lower than other large international seed companies. This results in low capital investment in R&D of new varieties. As for

the many small enterprises, the lack of financial capital restricts their overall competitiveness, particularly their capacity for R&D and marketing.

The rapid expansion of market stakeholders has resulted in the following consequences for the entire seed industry in China:

- (1) Homogenous varieties appear in the market. Most small enterprises lack the financial and technical capacity to develop new varieties, and most do not produce varieties they have developed themselves.
- (2) Unregulated market competition and high market competition pressures on many small seed enterprises.
- (3) Supply exceeds demand in the rice and corn seed market, which results in a large surplus of seeds and causes prices to fall, impacting the profits of individual seed companies.

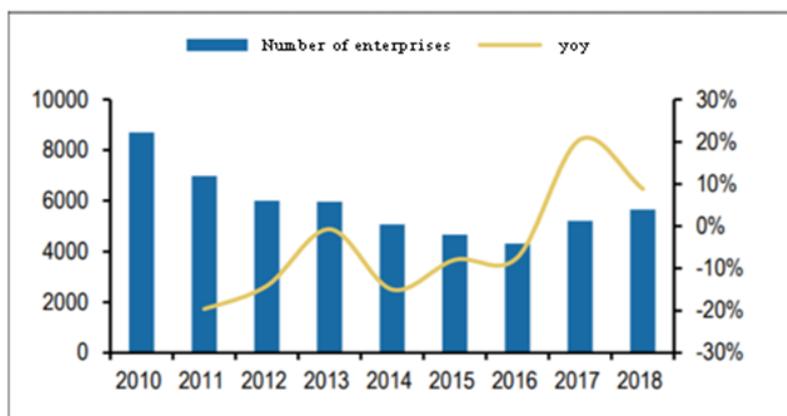


Figure 12 The number of seed enterprises in China exceed 5,000 by 2018
Source: Website of China Industrial Information

3.2 Major Chinese seed breeding and production enterprises

During the recent, rapid market expansion some seed enterprises gradually developed their R&D by increasing investments and merging small and medium-sized seed companies. This enabled them to develop their production and marketing capacity to become the leading seed companies in China. the leading Chinese seed enterprises include:

- (1) Longping Hi-Tech Co., Ltd., founded and registered in 1999 in Hunan Province and named after its founder, Professor Yuan Longping, a globally recognized rice breeder and an academician of the China Engineering Academy. The company’s products include hybrid rice, corn and vegetable seeds. Longping Hi-Tech is the largest rice seed producer in China. In the past twenty years, it has acquired eleven smaller competitors and is now one of the largest eight seed companies worldwide. (<http://www.lpht.com.cn/>;<https://www.lpseed.com/>)
- (2) Denghai Seed Co., Ltd, was founded in 1985 in Shandong Province. The original founder is Mr. Li Denghai. Today, the company is still a leading breeder of hybrid corn varieties in the country. Its breeding bases and marketing network cover all provinces in China except Qinghai and Tibet. Currently, the company’s major product is corn seed, along with wheat, vegetables and flowers. In the 1990s, Denghai Seed held about 43% of the corn seed market in the country and over 90% of the market in Shandong Province alone. (<http://www.sddhzy.com/>)
- (3) Gansu Dunhuang Seed Group Co., Ltd, founded in 1998, is registered in Dunhuangi, Gansu

- Province. Its major seed products include those of corn, vegetables, fodder, flowers, sugar beet and rapeseed. To date, the company has merged and purchased seven seed companies within Gansu and other provinces in China.
- (4) Hefei Fengle Seed Co., Ltd was established in 1984 as the Hefei Municipality Seed Company. In 1997, it was the first seed company in China to be granted stock market access. As a company listed on the stock market, it has expanded its production and marketing capacity by establishing and purchasing smaller companies in Anhui and other provinces. Its major seed products include rice, corn, vegetables, watermelon, etc. (<http://www.fengle.com.cn/about/?113.html>)
 - (5) The China National Seed Group Co., Ltd (CNSG), was established in 1978 under the Ministry of Agriculture. In 2007, CNSG was purchased by SinoChem. Through 40 years of development, CNSG has developed into the largest seed firm in China, with branches in all provinces of the country. Its products include seeds of rice, corn, wheat, vegetables, oil crops, cotton and fodder crops. The company's operational areas include seed breeding R&D, seed production and processing, as well as seed-related services such as marketing, thus covering the entire seed value chain. Currently, CNSG seed is produced at 650,000 mu seed production bases, 15 processing bases and 23 provincial seed marketing service centres. The seed production bases cover six geographical regions in China: the Northeast, Northwest, Southwest, South China, and the Yangtze River and Huang-Huai Regions (Yellow River and Huai River catchment area). By purchasing the corn-breeding arm of Monsanto, CNSG established CNSG International Co., Ltd. (<http://www.chinaseeds.com.cn/2445.html>)
 - (6) Anhui Quanyin (Win-All) Hi-Tech Co., Ltd, was established in 2002 in Anhui Province. In 2012, the company was listed on the stock market. Its major seed products include hybrid rice, corn, wheat, oil crops and vegetables. The company has established or purchased 9 subsidiaries within Anhui and other provinces in China. SinoChem Agriculture is the largest shareholder in the company, which is licensed by MARA to breed, produce and market seeds. By 2019, Win-All Seed had already established a marketing network in 16 Provinces in China and exported its seeds to more than 20 countries and regions in the world. (<http://www.winallseed.com/list/71.html>)
 - (7) BeidahuangKenfeng Seed Co., Ltd, was founded in 2001 in Harbin by Beidahuang Agricultural Development Co., Ltd. Its major seed products include hybrid rice, corn, soybean, wheat, sugar beet, and vegetables. The company was certified by the China National Seed Association as one of the 32 leading national seed-breeding and production corporations in the country. In 2013, Kenfeng Seed was listed on the stock market and has since established: (i) an R&D system with three R&D centres, 13 regional seed laboratories and 60 seed-testing stations, all drawing on annual R&D funds of 100 million Yuan; (ii) a breeding, production and processing system with approximately 1 million mu seed breeding and production bases in Hainan and other provinces in Southern and Northern China; (iii) a seed marketing and customer service system equipped with modern digital and intellectual technologies. (<http://www.kenfeng.com/>)
 - (8) Liaoning Dongya Seed Group Co., Ltd, was established in 1993 in Shenyang, Liaoning Province. Through 20+ years of development, this corporation has built a complete seed value chain consisting of seed R&D, seed breeding and production, seed processing and marketing, as well as production-related input and technical services. Its market network covers 25 provinces, with 60 subsidiaries across the country. Dongya has been ranked as one of the Top 10 seed enterprises in China. The Fuyou Seed is a famous brand in China. The company produces seeds of corn, silage

corn, rice, soybean, sunflower, millet, sorghum, potatoes, vegetables, flowers, forage crops, tree seedlings, etc. In 2015, Dongya was certified by the China Seed Association as an AAA seed enterprise. In the past 20 years, the company has established partnerships with the China Agricultural University and the Chinese Academy of Agricultural Sciences. It has also cooperated on technology with the German Bayer, Swiss Syngenta and USA Du Pont corporations. (<http://www.fuyouseed.cn/>)

- (9) Beijing JinseNonghua Seed Co., Ltd, was founded in 2001 in Beijing. The company is mainly engaged in breeding hybrid rice and corn seeds but also supplies fertilizers and pesticides, as well as agricultural machinery services. The company set up breeding subsidiaries in Hunan, Hubei and Jiangxi Provinces, and more than 20 marketing agencies in other provinces. Currently, it has about 200,000 mu rice and corn seed breeding areas in Sichuan, Gansu, Xinjiang, Guangdong and Guangxi. Its marketing and client services include approximately 3000 pilot areas with more than 20,000 demonstration sites around the country, all of which are provided with technical and information services. (<http://ahnzw.com.cn/web-34.html>)
- (10) Beijing Origin Seed Co., Ltd, was established in 1997 in Beijing. Its major seed products include corn, rice, cotton, rapeseed and vegetables. In 2012, the company was certified by the Ministry of Agriculture as among the top 10 enterprises for integrated seed breeding, production, processing and marketing. In 2000, the company received the ISO 9000 quality certification. Over more than two decades, it has established R&D centres, constructed seed-breeding and production bases in different regions of China and built a marketing network across the entire country. The company has also developed an export market in south-east and south Asian countries. In 2016, Origin Seed signed a cooperation agreement with Du Pont Pioneer.

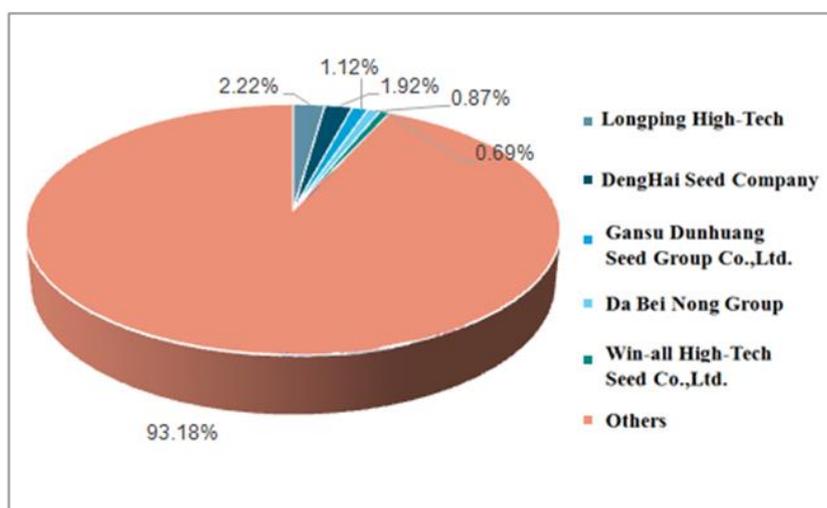


Figure 13 The market share of five major Chinese seed enterprises in the Chinese seed market

All the aforementioned domestic operators developed their integrated value chains of seed R&D, seed breeding and production, seed processing, marketing, and technical services. However, the overall R&D capacity and market share of each individual company is still relatively small (see Figure 12). The market share of the five leading Chinese seed companies is approximately 7%, whereas the remaining 93% is shared among the international seed corporations and roughly 5000 small and medium-sized domestic companies.

3.3 Major multinational seed enterprises in the Chinese seed market

Multinational enterprises began to market seeds and invest in China at the beginning of the 1980s. However, since 2000, and particularly after the country's entry into the WTO, China granted international seed companies access to its domestic market. By 2019, 35 of these enterprises had entered the Chinese seed market. The most competitive among them include:

(1) DuPont Pioneer China

DuPont Pioneer is a branch of DuPont, the world's largest breeder of corn seed, with the largest corn-breeding genetic resources (60% of global corn gene resources). Pioneer Seed was founded in 1926, and later merged with DuPont. In 1997, Du Pont Pioneer (USA) set up its representative office in Beijing. In 1998, Tieling Pioneer Seed Development Co., Ltd., was set up, followed in 2002, by the founding of Denghai-Pioneer Seed Co., Ltd in Shandong Province as a joint venture. This corporation, 51% of which was shared by Denghai Seed and 49% by DuPont Pioneer, was primarily engaged in the production of summer corn seeds. In the same year, a seed processing plant was constructed in the city of Jiuquan, Gansu Province. In 2006, Dunhuang Pioneer Seed Co., Ltd was established as a joint venture of Dunhuang Seeds and DuPont Pioneer. A year later, DuPont Pioneer set up a joint venture with Beijing WeimingKaituoBioTech and formed the Kaituo-Dien Bio-Tech Centre. By 2019, DuPont Pioneer had about 1000 employees in China. (<https://www.pioneer.com/web/site/china/about-pioneer/>)

(2) VilmonrinLimagrain (French)

Founded in 1942 in France, Limagrain (LG) is the world's second- and fourth-largest producer of vegetable and grain seeds, respectively. LG entered the Chinese market in 1993 and set up its first subsidiary in 1997. In 2002, LG established Shanxi Limagrain Special Grain Seed Development Co., Ltd, along with the Shanxi Wheat and Hebei Corn Seed Experimental Stations. In 2005, vegetable seed experimental stations were established in Shandong and Gansu Provinces, and in 2006, LG set up its corn seed breeding stations in Shanxi and Jilin. By 2009, the LG (China) Technical Service Company and LG Commercial Service Company had been established in Beijing. In thirty years of sustainable development, the company has contributed to the innovation of Chinese wheat, corn and vegetable seeds and made a significant contribution to improving agricultural productivity in China. (<http://www.limagrainchina.com>)

(3) KWS Saat AG (China)

KWS Saat AG was established in 1856 in Kleinleben, Germany. Today, the company operates its seed breeding and marketing business in about 70 countries and regions of the world. As a group company, KWS has about 70 subsidiaries or affiliated enterprises. Its sales revenue in the 2018-2019 fiscal year was 1.68 billion Euros, with pre-tax profits of 133 million Euros. R&D investment in the 2018-2019 fiscal year reached 190 million Euros, approximately 12% of the sales revenue and 1/3 higher than the annual pre-tax profit. Currently, the company has approximately 5500 employees, including 2100 involved in research. Major KWS seed products include: sugar beet, corn, wheat, black wheat, barley, oats, soybean, peas, and oil crops such as rapeseed and sunflower.

Since China has the second-largest seed market in the world, KWS identified the country as a major target. In 2015, Kenfeng-KWS Seed Co., Ltd. was established as a joint venture company in China, with

Kenfeng taking a 51% stake and KWS, the remaining shares. KWS also set up KWS Agricultural Co., Ltd in Beijing. In 2019, KWS had about 3% of the market share of hybrid corn seeds in the Chinese market. The major breeding objective is to increase productivity by raising crop resistance to pests, diseases, drought and low temperatures, developing high-quality and widely-utilizable fertilizers, etc. (<https://www.kws.com/cn/zh/gongsi/gailan/>)

(4) Bayer Crop Science in China

Established over 160 years ago, Bayer is the largest multinational corporation operating in the fields of macromolecule chemistry, pharmaceuticals, biotechnology and crop sciences. Crop Science is the largest crop-production and breeding company in the world with R&D, seed production and marketing operations in about 90 of the world’s countries and regions. Bayer Crop Science China was established in 2000 in Hangzhou, as a branch of Bayer Group. Bayer Crop Science develops plant protection products and crop seeds. In the past 20 years, Bayer Crop Science has already established eight experimental farms and marketing agents in 22 provinces in China. Its major products include rice seeds, rapeseeds, cotton seeds, vegetable seeds, as well as herbicides and pesticides.

In 2018, Bayer successfully purchased Monsanto, the largest breeder of genetically-modified seeds in the USA, thereby becoming the largest seed breeder in the world. Through its acquisition of Monsanto, Bayer also took over Monsanto’s China operations, including the joint venture company with the China National Seed Group. (<https://www.cropscience.bayer.com.cn/>)

(5) Corteva Agriscience, USA

Corteva Agriscience was founded in 2019 as a standalone company drawing on the rich agricultural sciences and seed-breeding heritage of Dow, DuPont and Pioneer. The newly-established company has three major divisions; namely, seed technologies, plant protection and digital agriculture. After the merger, Corteva Agrisciences took over DuPont Pioneer in China and its affiliated joint ventures in the country. (www.corteva.com)

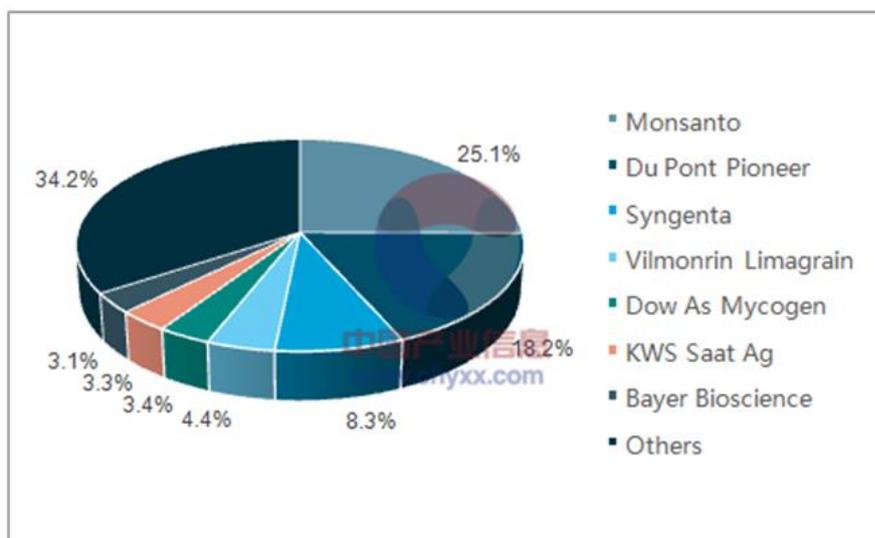


Figure 14 Chinese seed market integration degree

4. Analysis of crop seed supply and demand in China

4.1 Rice seed production, supply and demand

China is the second-largest rice production country in terms of rice-sown area. From 2009 to 2019, the average annual rice-sown area varied from 29 million to 30 million ha. The annual hybrid rice seed demand is about 250 million kg. However, rice seed production and supply has always exceeded demand. As the unit yield increases, the sown area has experienced continuous annual decline. However, no corresponding decline in the surplus produced has yet occurred.

Rice seed production and supply

In the past twenty years, China has developed an effective hybrid rice seed breeding and production system, with both the seed breeding areas and seed production remaining constant at 1.5-1.6 million mu. Meanwhile, the seed yield has varied between 160 kg/mu and 180kg/mu. Figure 15 illustrates the area of land used for hybrid rice seed breeding between 2013 and 2019.

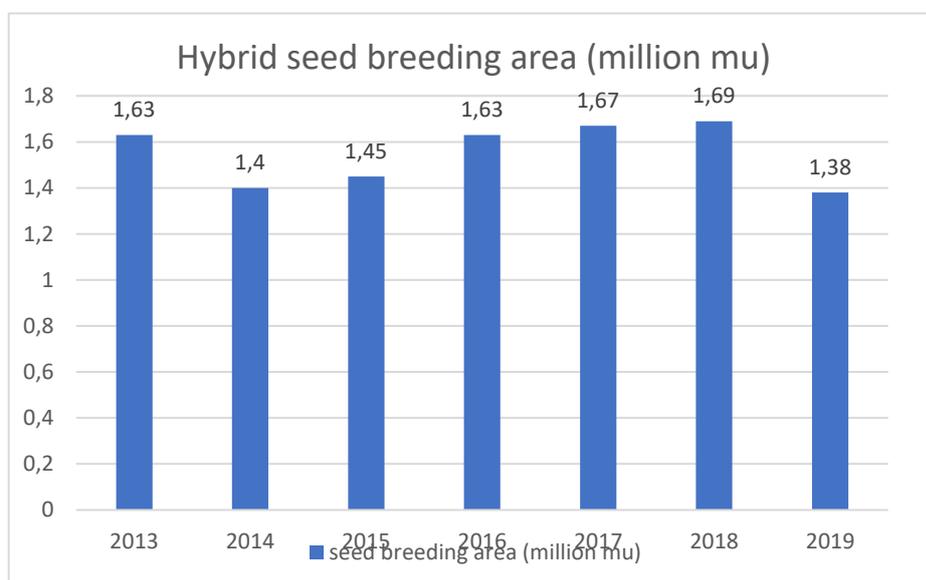


Figure 15: 2013-2019 China Hybrid Rice Seed Breeding Area
Source: Qianzhan Industry Research Academy, 2019

(1) Rice seed production and supply capacity

Annual rice seed production plus the inventory backlog of the previous year constitutes the annual quantity available to market. The data in Figure 16 shows the average annual capacity of rice seed supply to be 375 million kg, with annual variations ranging between 340 and 410 million kg. Since 2010, the capacity to supply rice seed has always exceeded the annual seed demand and resulted in a constant surplus of rice seed in the country.

Major factors which determine annual rice seed supply and demand include:

- The annual area of land turned to seed-breeding, yield and production;
- Variation in the number of rice seed-breeding and processing enterprises;
- The amount of inventory backlog from the previous year;
- Annual variation in the amount of land used for production;

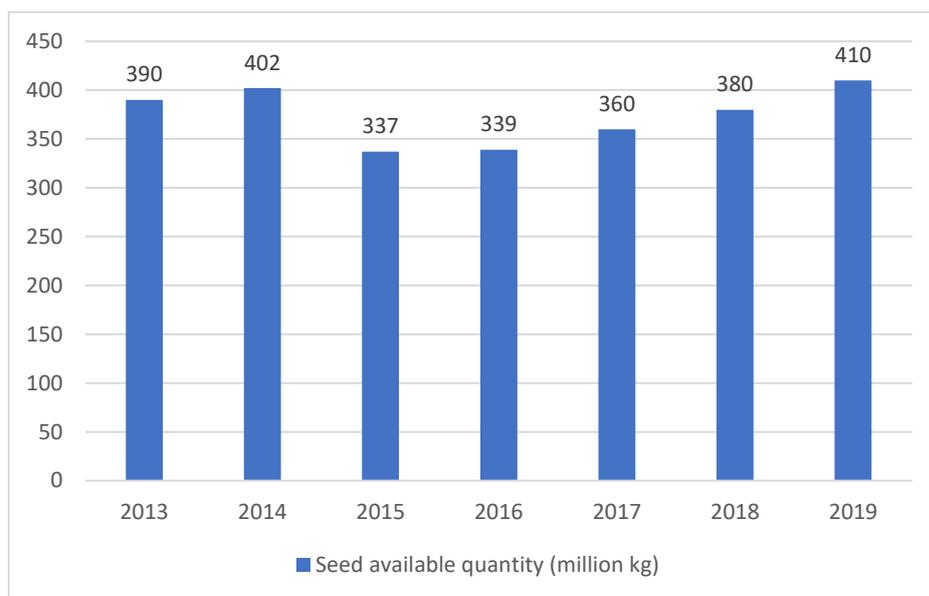


Figure 16: The available rice seed quantity in China from 2013 to 2019
 Source: China QianzhanIndustry Research Academy

(2) The demand for hybrid rice seeds

According to the National Bureau of Statistics (NBS), the annual sown area of rice crops in China is around 30 million ha, a figure which includes the area of twice-harvested paddy rice growing in provinces of the southern Yangtze River. Between 2013 and 2017, the total land area of rice production was quite stable, at 30.60-30.80 million ha. Affected by reduction in the market price of rice and, increasing input costs, this reduced to 32.00 million ha in 2018, and had further declined by 1.6% to 29.60 million ha by 2019.

The average seed demand for the period from 2013 to 2019 was about 250 million kg, varying from 210 to 270 million kg. The demand for seed is determined by the quantity of sown areas and the quality of the rice seed. Figure 17 shows a declining trend in demand for hybrid rice seed in China.

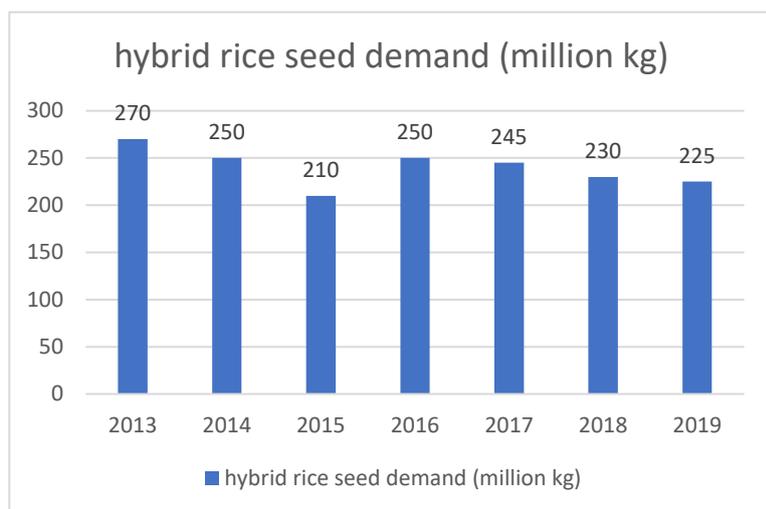


Figure 17: Hybrid rice seed demand in China from 2013 to 2019
Source: China Qianzhan Industry Research Academy, 2019

(3) The increasing annual rice surplus

Figure 18 shows a “V-Shaped” change in the rice surplus. From 2013 to 2016, the annual surplus of hybrid rice declined from 130 million kg to 80 million kg, whilst from 2016 to 2019, the surplus increased from 80 million kg to 160 million kg. Despite this variation, there are large surpluses of rice, equivalent to between one and two-thirds of annual demand.

4.2 Hybrid corn

China is one of the largest corn producers in the world, with corn constituting 25% of the country’s total grain crop production. The primary use of corn is as feedstuff for livestock and poultry. In 2015, MARA initiated agricultural supply-side reform through the restructuring of grain crops. One impact has been a sharp reduction in the planting area of hybrid corn and the increase of the planting area of soybean and cash crops. The deficit between production and consumption is balanced by imports from other countries. This restructuring policy has also affected the production and supply of corn seed.

(1) Hybrid corn production and supply capacity

In response to the agricultural supply-side reform, the seed-breeding area in 2017 fell from the previous year’s 4.1 million mu to 2.93 million mu, and subsequently dropped to 2.56 million mu in 2019.

Accordingly, corn production also declined from 1.36 billion kg in 2013 to 0.99 billion kg in 2019. However, the overall amount of available corn (i.e., the supply capacity) remained above 2.0 billion kg, while varying between 1.7 billion and 2.36 billion kg.

(2) Demand for corn seed remained stable

The figures in Table 1 show that, with the exception of 2013, the annual demand for corn remained between 1.1 and 1.2 billion kg, at least 35-50% lower than the annual available amount.

Table 1 Supply and demand of hybrid corn seed in China (Source: Website of Chinese industrial information)

Year	Unit	2013	2014	2015	2016	2017	2018	2019
Hybrid com: Seed production area	Thous and mu	3820	2940	3420	4100	2930	2370	2560
Hybrid com: Seed production unit	kg/mu	356	332	322	370	340	389	387
Hybrid com: Amount of seed production	Billion kg	1.36	1.01	1.096	1.465	1.058	0.922	0.99
Hybrid com: Available seed quantity	Billion kg	2.11	2.36	2	1.846	2	1.8	1.621
Hybrid com: Seed demand	Billion kg	0.77	1.15	1.2	1.175	1.15	1.1	1.1
Hybrid com: Inventory	Billion kg	1	1	0.75	0.6	0.8	0.7	0.65

(3) A large amount of corn seed surplus in the domestic seed market

As Figures 19 and 20 show, there were large surpluses of corn between 2013 and 2019. In 2013 and 2014, the surplus reached 1 billion kg, which is almost as high as the annual demand. Even in 2016, the year with highest corn-planting area, the surplus continued to exceed 500 million kg. Such high surpluses in annual supply have led to tough competition between different seed-breeding enterprises and driven down profits.

Reasons for imbalances in supply and demand are as follows:

- (1) MARA approved many new corn varieties for release on the seed market in 2013 and 2014;
- (2) The qualification requirements for enterprises’ access to the seed market were loosened in 2015. A large number of such enterprises were founded in the past ten years, producing the low CR which results from a market overcrowded by smaller companies.
- (3) Supply-side reforms reduced the corn planting area, and domestic demand has shrunk accordingly;
- (4) A channel for exporting corn seed has not yet been effectively established; on the other hand, the seed quality is not competitive in the international market in comparison with the products provided by multinationals such as DuPont Pioneer or Monsanto.

To change this situation, MARA must review the existing regulations to speed the development of market reform by, for instance, promoting mergers between smaller seed-breeding competitors.

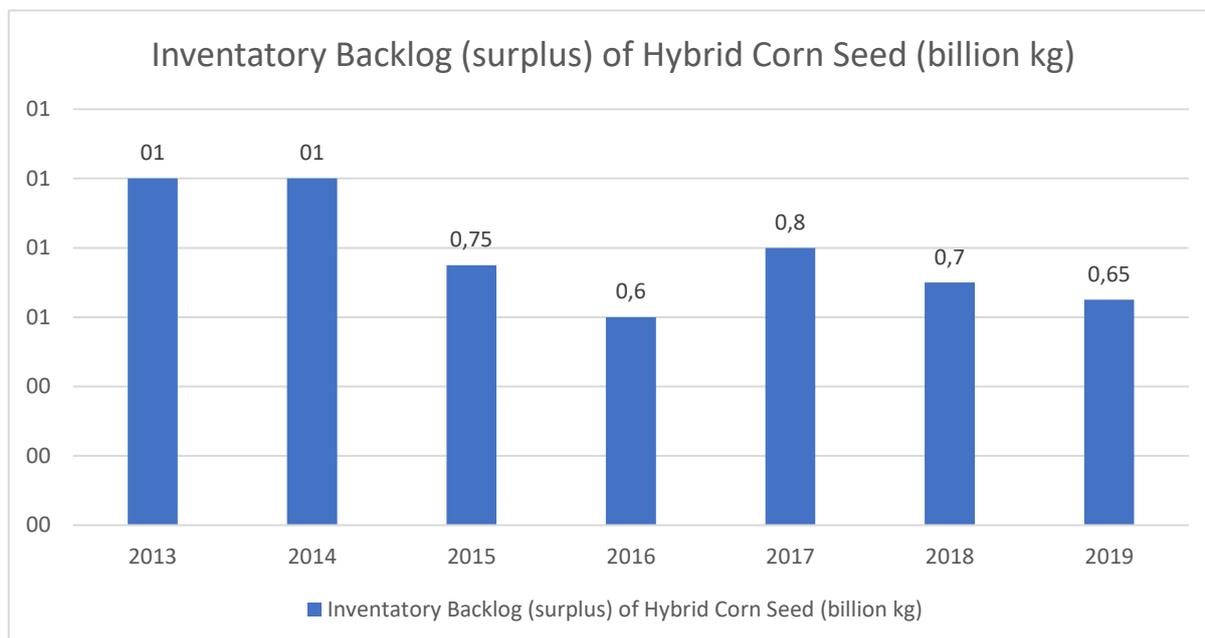


Figure 18: Corn seed supply surplus in China from 2013 to 2019
 Source: Website of China Industrial Information

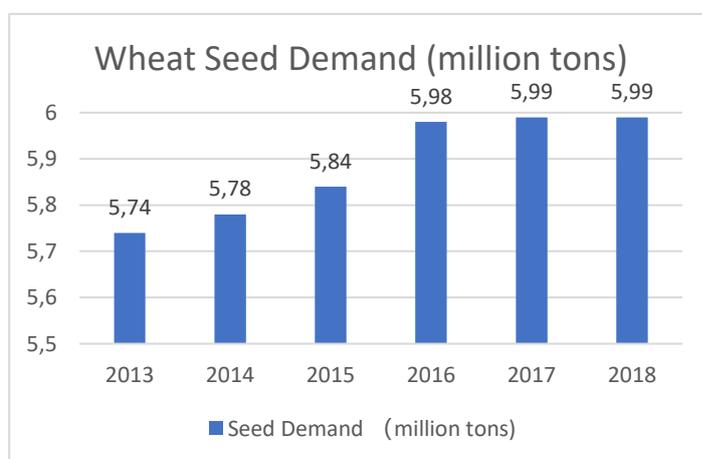


Figure 19: China’s wheat seed demand from 2013 to 2018
 Source: Zhiyan Industry Consulting Institute

4.3 The wheat seed market

China is one of the largest wheat producers and consumers in the world, with wheat yields increasing from 92 million tons in 2006 to 134 million tons in 2019, with a CAGR of 2.52%. From 2013 to 2018, China’s wheat-sown area stabilized at 24 million ha and the annual demand was approximately 5.5-5.9 billion kg (see Figure 20).

(1) The fast-growing seed market

China’s wheat seed market expanded very fast from 2012 to 2018. During this period, its market value increased from 9.6 billion Yuan in 2012 to 24.6 billion Yuan in 2019, an increase of about 61% (see Figure 21). The wheat market accounts for approximately 20% of the total Chinese crop market. Two factors have accelerated the rapid growth of the wheat market: (i) The commercial rate of wheat in China has increased from 53% in 2012 to 80% in 2019. Improvements in technical services made

available by seed enterprises have increased their uptake by individual farmers who increasingly realise the yield and quality of the products; (ii) The per ha seed price has increased year by year, according to the Qianzhan Industry Research Academy, the seed costs in 2019 was 50% higher than that of 2012.

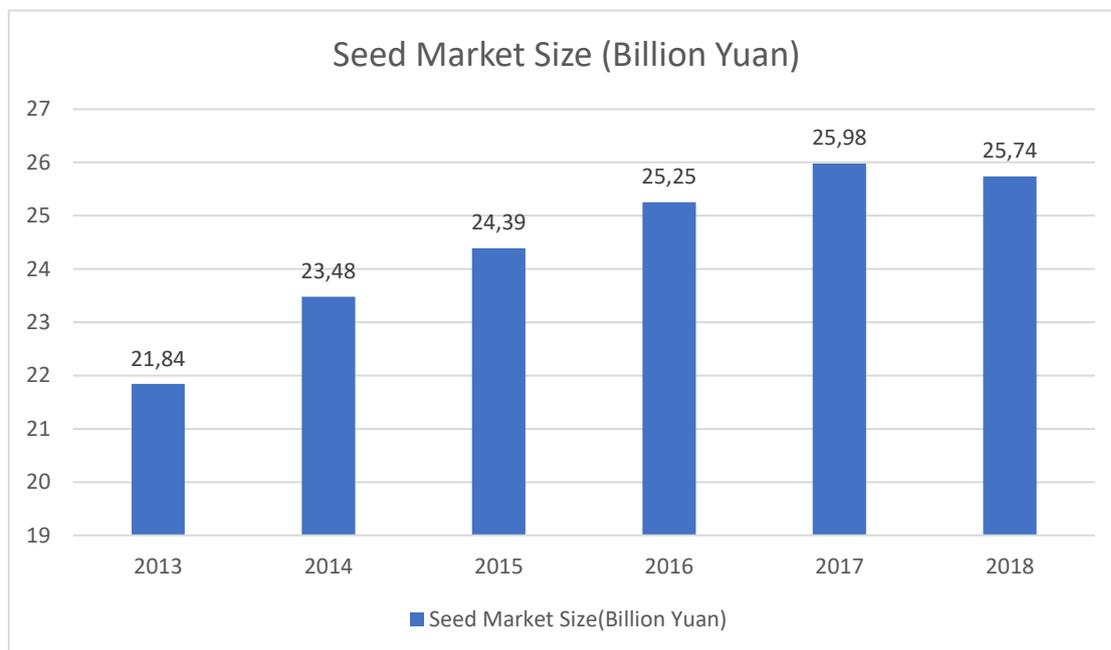


Figure 20: China wheat seed market demand (2013-2018)
 Source: MARA, Zhiyan Industry Consulting Institute, 2020

(2) Potential to further increase the commercial rate of wheat

Most researchers estimate that the commercial rate of wheat seeds in China is between 70% and 80%, meaning there still exists 20-30% of market potential to be exploited. The estimated gap for commercial wheat seeds is about 110 million kg (Qianzhan and Zhiyan Industry Academies). Most wheat seeds currently used in wheat production are conventional varieties, meaning that farmers and wheat growers can select and produce seeds by themselves. However, the high-yield and high-quality commercial wheat varieties can ensure further increases in the productivity and profit margins of wheat growers. In addition, there is also a demand for less-common, ‘niche’ wheat varieties such as traditional Chinese varieties that have a high starch content but less gluten and protein, making them unsuitable for bakery bread. Currently, China is a large importer of bakery wheat.

(3) High competition in the Chinese wheat seed market

The number of wheat varieties approved by the government is too large. According to MARA, from 2011 to 2019 the total number of approved wheat varieties increased from 2200 to 3700, meaning that about 1500 new varieties were approved and supplied to the market in this period. Among 3777 varieties, 619 have been approved and certified by the national government, and 3158 by local authorities. This causes a very low concentration ratio of the seed market, characterised by low market shares of small wheat seed-breeding companies and high levels of homogenization of the wheat seeds themselves. Overall, wheat seed production and market supply need to be further integrated and regulated.

4.4 Vegetable seed supply and demand

(1) China’s demand for vegetable seed has increased rapidly over the past ten years

As China’s per capita income increased, the consumption of vegetables has risen rapidly over the past two decades. This increase in consumption has boosted the rapid growth of the land area used to grow vegetables. According to the Industrial Research Institute, based on data provided by MARA and the National Bureau of Statistics (NBS), the annual vegetable-sown area

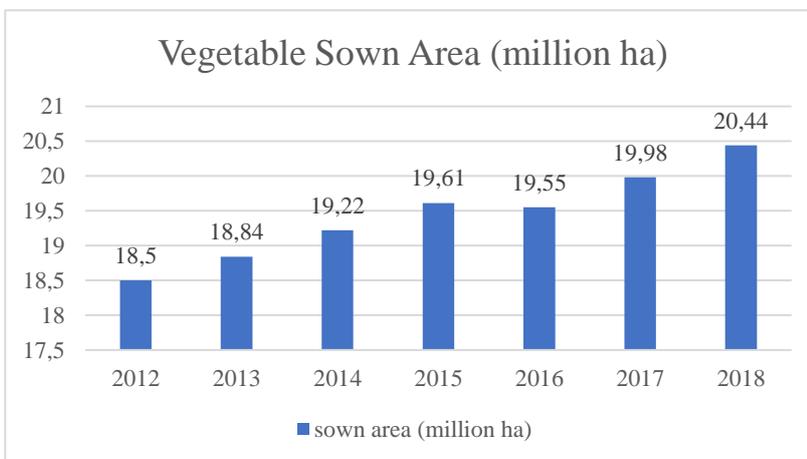


Figure 21: 2012-2018 China vegetable sown area
Source: MARA, NBS

increased by about 2.9% between 2007 and 2018, and the annual growth in production reached 3.4%. Figure 22 illustrates the vegetable-sown area increase from 2012 to 2018.

(2) The large vegetable seed market value in China

As the land area given to vegetables increased, its market value rapidly grew from 15.94 billion Yuan in 2016 to 20.26 billion Yuan in 2019, with an average annual increase of 7.8% (varying from 7.1% to 9.0%). According to market growth predictions, the total market value of vegetables will reach approx. 25 billion Yuan (3.5 billion USD [see Figure 23]).

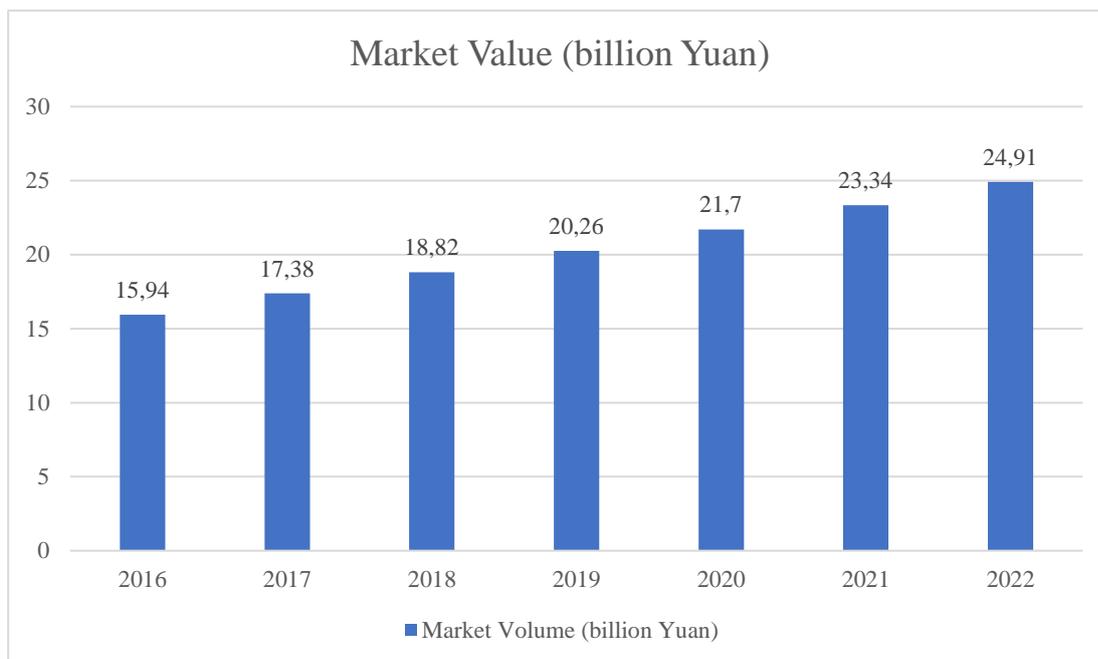


Figure 22: Estimated Chinese vegetable seed market value from 2016 to 2022
 Source: China Industry Research Web: <http://www.chinairr.org>

(3) The vegetable seed market demand and production in China

Driven by the fast growth in demand for vegetables, by governmental policy and the liberalization of the market over the past two decades, China’s vegetable breeding and marketing system is now well-established. The vegetable seed production capacity has slightly increased in the past three years. The total production of major vegetable seeds in 2017 was 59,700 tons, short of meeting the demand in

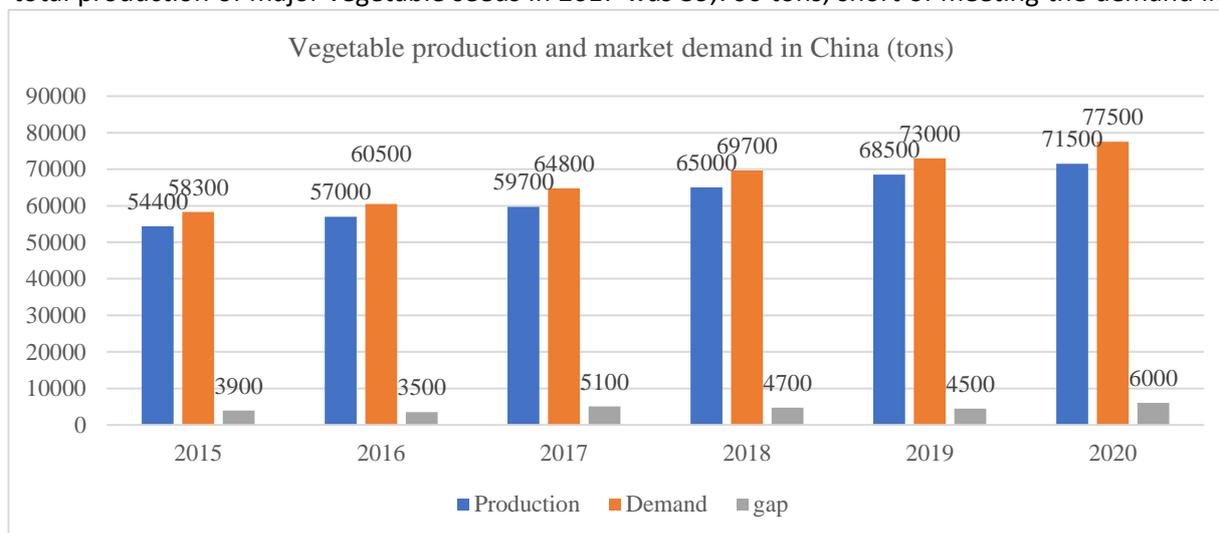


Figure 23: Vegetable seed production and demand in China from 2015 to 2020
 Source: MARA, China Industrial Information Center <https://www.chyxx.com/research/201902/716737.html>

the vegetable production sector (see Figure 24). As a result, the total market gap is between 5000 and 10000 tons per year, which must be filled by imports.

(4) China is a net vegetable seed importer

Although the Chinese vegetable seed market developed very rapidly in the past ten years, there is still high potential demand for these seeds on the market. It is estimated that, in 2018, the size of the Chinese vegetable seed market was about 14 billion Yuan (about 2 billion USD), with imports making up the shortfall. Table 2 and Figure 25 below show the vegetable seed imports and exports from 2012 to 2018.

According to China’s General Administration of Customs (CGAC), China imported 8709 tons of vegetable seeds with a total trade volume of 228 million USD in 2018. In the same year, large Chinese vegetable seed-breeding companies exported 4052 tons of vegetable seeds with a trade volume of 121 million USD.

Table 2 China’s Vegetable Seed Import/Export Value from 2012 to 2018

year	Export (kg)	Export value (1000 USD)	Import (kg)	Import value (1000 USD)	Net import (kg)
2012	6130927	158832	7705007	113921	1574080
2013	6119886	146492	7829021	125371	1709135
2014	4251740	175952	10044595	152416	5792855
2015	5383338	161199	9305681	172045	3922343
2016	9175592	113178	9665015	176554	489423
2017	4492181	120478	9571286	201465	5079105
2018	4052132	120724	8707042	227988	4654910

Source: China General Administration of Customs (CGAC), ZhiyanIndustrialConsulting Institute.

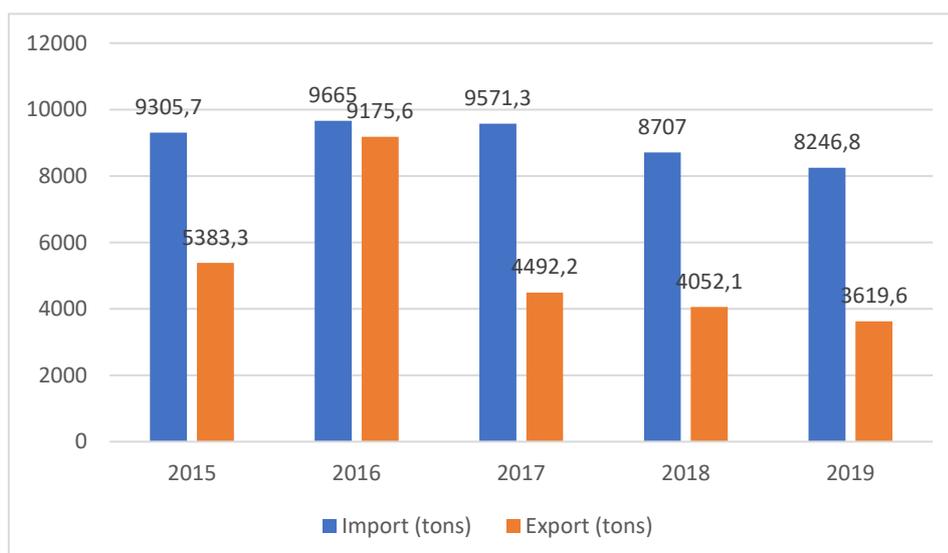


Figure 24: Vegetable seeds in China: statistical data on imports and exports (2015-2019)

Source: MARA, GAC, Zhiyan Industry Consulting Institute, 2020

5. Regulatory institutions for the Chinese market and trade in seeds

The management of the Chinese seed industry and market is mainly regulated by an agency of the Chinese national government; namely, the Department of Seed Industry (DSI) of the Ministry of Agriculture and Rural Affairs. At the same time, the China National Seed Association (CNSA) and China National Seed Trade Association (CNSTA), guided by the Bureau of Seed Management and organized by stated-owned seed companies, play a certain role in assisting in the management and development of the seed industry. China has enacted special laws and regulations on seeds. Following amendments, the latest version of the Seed Law of the People's Republic of China was promulgated on January 1, 2016. There are four regulations to support the use of this law: Measures for the Administration of Labels and Use Instructions of Crop Seeds, Measures for the Administration of the Production and Business License of Crop Seeds, Measures for the Approval of Key Crop Varieties, and Measures for the Registration of Non-main Crop Varieties.

5.1 Governmental departments

(1) Department of Seed Industry (DSI), MARA

This specialized seed management agency was established at the founding of the People's Republic of China and has undergone several phases of institutional adjustment, and redistribution of powers and responsibilities. China's earliest professional seed-management agency was established in July 1956, affiliated to the Ministry of Agriculture, and was charged with administering the national seed industry. In order to further strengthen China's abilities to control and allocate seed operations, the seed-management functions were decentralized after 1978. Specifically, the agency's administrative rights were transferred to the Seed Department under the MOA Department of Plantation Management; technological aspects of the seed industry were guided by the National Agricultural Technology Extension Service Centre, which was another institution under the MOA Department of Plantation Management; the seed conditioning and seed import-export business of the national seed market were undertaken by the newly-established China National Seed Group Co., Ltd.; and the responsibility for the protection of new plant varieties was assigned to other departments.

In order to strengthen the national management of the seed industry, the Ministry of Agriculture re-established the Seed Management Authority in September 2016, promoting it to a department-level, agency, and established the Office of General Affairs, Division of Seed Industry Development, Division of Variety Management, and Division of Market Regulation under its supervision. With the formal establishment of the Bureau of Seed Management, China also accelerated the process of merging and acquisition of seed companies, an important step towards implementing the national strategy of the seed industry.

On April 3, 2018, the Ministry of Agriculture was renamed the Ministry of Agriculture and Rural Affairs of the People's Republic of China. In August of the same year, the Seed Management Authority was expanded by adding the management of the livestock and poultry seed industry and was officially renamed the Department of Seed Industry of the Ministry of Agriculture and Rural Affairs. The Department currently has the following divisions: the Office of General Affairs, the Division of Crop Seed Industry Development, the Division of Livestock and Poultry Variety Industry, the Division of Variety Innovation, and the Division of Market Regulation (the function of each Division of the Bureau of Seed Management is shown in Table 3). The functions of the DSI are mainly as follows: drafting the

developmental policies and plans for the crop, livestock and poultry seed industries; organizing and implementing the protection and management of crop germplasm resources and livestock and poultry genetic resources; supervising and managing the development of crop seeds and seedlings; organizing the storage and allocation of seeds for disaster relief and disaster preparedness; and undertaking the protection of new varieties of agricultural plants and other related work.

Table 3: Functions of Divisions of the Bureau of Seed Management of the Ministry of Agriculture and Rural Affairs

Division	Functions
Division of Crop Seed Industry Development	(1) To collect and analyze information on the seed industry, guide the regulation of the seed market, and organize the storage and allocation of seeds for disaster relief and disaster preparedness.
	(2) To formulate development strategies and plans for the crop seed industry, propose relevant policy suggestions, and organize their implementation.
	(3) To draft laws, regulations, rules and standards related to the crop seed industry.
	(4) To organize the protection and management of crop gene and germplasm resources, and undertake approvals of imports and exports of crop seeds or seedlings, and germplasm resources.
	(5) To review and issue licences for crop seed production and commerce, and communicate reviews to foreign-invested seed enterprises.
	(6) To undertake the management of crop seed reproduction in some districts of Hainan province.
Division of Variety Innovation	(1) To organize crop variety management, formulate administrative measures and standards for crop variety review and approval as well as for the protection of new varieties.
	(2) To undertake the review and registration of crop varieties, authorize and reexamine new varieties of agricultural plants and facilitate the exit of varieties from cultivation.
Division of Market Regulation	(1) To supervise the implementation of laws, regulations, rules and standards concerning the crop, livestock and poultry seed industries.
	(2) To conduct seed quality supervision and sampling inspections and evaluate the performance of seed inspectors and related institutions.
	(3) To guide the construction of a seed management system, undertake the management of seed production, business operations and quality supervision.

Resource: website of MARA: <http://www.zys.moa.gov.cn/jgznl/>

(2) National Agro-Tech Extension and Service Centre (NATESC)

NATESC was established in 1995 when the National Seed Station, the National Plant Protection Station and the National Fertilization Station were combined. As a governmental authority, NATESC is affiliated with MARA. There are also Agri-Tech Extension and Service Centres at provincial and county levels.

NATESC has five major functional mandates, which are as follows: Seed and Seed Industry Administration; Fertilization and Irrigation; Plant Protection; Crop Production and Cultivation, and Extension System Construction. NATESC is an important governmental authority for supervising,

regulating and guiding seed R&D, experiments and extensions of these, particularly the registration, certification and quality quarantine of crop seeds.

Among the 22 functional divisions of NATESC, the following have mandates in seed market and seed production management:

- (1) The Division of Seed and Variety Regional Experimentation and Trials: mainly responsible for guiding and carrying out new variety extension trials and experiments prior to registration; instructions for the import and introduction of new varieties.
- (2) The Division of Crop Seed and Variety Registration: responsible for the certification and registration of new crop seeds and varieties according to the results of experiments and trials of these.
- (3) The Division of Seed Quality Test: testing seed quality according to the governmental seed quality standards.
- (4) The Division of Seed Market Supervision: supervision of the operation of the seed market and monitoring seed market prices;

In addition, the secretariats of the China National Seed Standardization Committee and National Crop Seed Quality Certification Committee are part of the NATESC.

The NATESC also maintains three important webpages for on-line seed registration and certification and seed market supervision:

- (1) The National Seed Market Price Monitoring System;
- (2) A reporting and registration system for the cultivation of crop seeds by provincial seed administration stations;
- (3) The National Seed Production Monitoring System.

5.2 Seed Industry Associations

Seed Industry Associations play important roles in regulating the seed market and promoting its development. They also play bridging roles between the government (DSI and MARA) and the seed-breeding enterprises. There are two major seed industry associations in China:

- (1) The China National Seed Association (CNSA)
- (2) The China National Seed Trade Association (CNSTA)

5.2.1 The China National Seed Association

Founded in 1980, the China National Seed Association is a national association for seed industry-related entities and individuals. CNSA is a non-governmental, non-profit and self-regulating organization. CNSA's mission is to serve its members in crop seed R&D, seed breeding and production, marketing their seed products and ensuring fair competition among seed enterprises and the sustainable development of the industry in China. Until the end of 2019, CNSA had 1102 members, of

which 51 were individual members, the rest consisting of legal entities, i.e., organisations and enterprises. CNSA is a member of the International Seed Federation and Asian-Pacific Seed Association.

CNSA, as a legal entity for the seed industry, is affiliated to NATESC and administratively supervised and guided by the Department of Seed Industry, MARA.

Under the CNSA Secretariat, there are five functional divisions:

- (1) The General Administration Office: formulation of CNSA regulations, organizing board meetings, maintaining the CNSA website, and online forums such as Public WeChat and coordinating communication with relevant governmental organizations and research institutions.
- (2) The Membership Service Division: Development of new memberships and daily communication with members; provision of seed industry-related regulatory and policy consultation services to members; coordination and communication with academic members of the association.
- (3) The International Cooperation Division: responsible for international cooperation, the promotion of exchanges between CNSA members and partner enterprises in foreign countries and facilitating members' expansion into foreign seed markets.
- (4) The Seed Enterprise Credit Rating Service Division: conducting credit rating and grading services to members, responding to the complaints of member enterprises, and mediation of disputes between members.
- (5) The Seed Industry Research Division: carrying out investigations and market studies into the seed industry, formulating industry standards, publicizing data and information related to the development of the industry in China and other countries; organizing researchers and professionals to provide consultancy services to members;
- (6) The Exhibition and Training Service Division: design and organization of seed industry exhibitions, participation in international seed exhibitions, planning and carrying out relevant training.

CNSA has established 14 branches under the crop variety and crop management requirements:

- (1) CNSA-Rice Seed Branch
- (2) CNSA- Corn Seed Branch
- (3) CNSA- Silage Corn Branch
- (4) CNSA- Edible Green Corn Branch
- (5) CNSA-Wheat Seed Branch
- (6) CNSA-Cotton Seed Branch
- (7) CNSA-Vegetable Seed Branch
- (8) CNSA-Potato Seed Branch

- (9) CNSA-Soybean Seed Branch
- (10) CNSA-International Cooperation Branch
- (11) CNSA-Branch for Breeding Companies of Southern China
- (12) CNSA-Mechanization Branch
- (13) CNSA-Seed Coating Branch
- (14) CNSA- New Plant Species Protection Branch

CNSA is also the hosting entity for the China Seed Industry Big Data Platform (<http://202.127.42.145/bigdata>). The targeted clients of this platform are CNSA members and their trade partners in the Chinese and global seed markets. The platform consists of the following 9 data folders:



Figure 25: The folders of China Seed industry Bigdata Platform

CNSA contact information:

Secretariat of CNSA

Address: 2nd Floor, Building No. 20, Maizidian Street, Chaoyang District, Beijing

Tel./Fax: 0086 10 59194250

Web: www.seedchina.com; www.seedchina.com.cn

5.2.2 China National Seed Trade Association

Established in 1988, the China National Seed Trade Association (CNSTA) is a national and industrial professional and non-profit organization formed by seed-breeding member enterprises and seed trade organizations. It represents the interests of China’s seed industry, aiming to form effective links between the Chinese government and its members, facilitating and promoting cooperation between Chinese seed production enterprises and seed enterprises in partner countries. At present, CNSTA is a non-governmental and self-regulating organization registered with the Ministry of Civil Affairs. The CNSTA was previously affiliated with the China National Seed Group Co., Ltd. (formerly known as the

China Seed Group, founded in 1978 from the former Seed Department of the Ministry of Agriculture, and also the first seed enterprise to be established in China's reform period). CNSTA is under administrative supervision of Ministry of Agriculture and Rural Affairs. It became a member of the International Seed Federation and ISF board member in 1995 and of the APSA in 2003. CNSTA is also a member of the International Seed Trade Federation (FIS). The President of CNSTA, Mr Song Weibo, is also an executive board member of FIS in the Asia-Pacific Region; the Secretary-General is Madam Tian Weihong.

CNSTA has more than 170 members, including Syngenta China, SinoChem Agriculture, Win-All, Bayer China, Corteva, Sakata, Limgrain China, Incotec, Nunhems Beijing Seeds, Anhui Longping Hi-Tech and other large domestic and international seed enterprises.

The business functions of CNSTA include:

- (1) Regulation of the Seed Industry and Market Management, based on governmental industry and trade policy.
- (2) Facilitation of information exchange between Chinese and foreign seed-trade partners.
- (3) Provision of seed business and trade-related training to members.
- (4) Facilitation and organization of seed marketing at domestic and international exhibitions;
- (5) Promotion and coordination of international cooperation in the seed trade.
- (6) Providing consultancy services to members.

To fulfill the business service functions mentioned above, there are five service divisions under the CNSTA Secretariat :

- (1) The Membership Service Division
- (2) The Import/Export Service Division
- (3) The International Exchange and Cooperation Division
- (4) The Seed Industry Investigation and Policy Study Division
- (5) The Conference and Exhibition Division

Besides these functional divisions, CNSTA also set up 5 working groups with designated tasks:

- (1) The Working Group for International Seed Trade
- (2) The Working group for protecting seed industry intellectual property rights
- (3) The Working Group for Hainan Free Trade Port
- (4) The Crop Working Group for Sugar Beet
- (5) The Crop Working Group for Broccoli

At the same time, entrusted by the relevant government departments, CNSTA also organizes member companies to discuss and collect opinions and suggestions on measures for seed import management. It also collects and compiles the import-export policies and regulations of relevant foreign countries and organizes investigation and research. It submits relevant reports on the internationalization of China's seed industry, including the seed import and export trade, to government authorities. The CNSTA also directly provides support to the government. In terms of foreign exchange and

cooperation, CNSTA actively strengthens its communication and exchanges with foreign seed associations, and jointly chairs discussions of the Plant Breeding Innovation Roundtable with the International Seed Federation to help promote scientific and technological innovation in China's seed industry.

In recent years, CNSTA has established partnerships with the following German associations and seed enterprises:

- (1) Bundesverband Deutscher Pflanzenzüchter (BDP)
- (2) Saatgut-Treuhandverwaltungs GmbH
- (3) CLAAS Machinery Co., Ltd
- (4) KWS SaatAG
- (5) Bayer, China
- (6) Nunhems (BASF)

In March 2019, in cooperation with Netherlands Plantum, German BDP and DCZ, CNSTA hosted a China-Netherlands-German Workshop on Enforcement of Plant Variety Protection, in Beijing. Representatives from Germany and other countries, such as BDP, KWS, CLAAS, Bayer, Nunhems, Corteva Co., Ltd, ASTA from the USA, Syngenta China, the Department of Seed Administration of MARA, NATESC, CNSA and others attended the workshop.

In 2019, CNSTA organized a study tour to the Netherlands and Germany in which delegates of Chinese seed enterprises visited Dutch and German seed and agricultural machinery enterprises, and discussed the possibilities of establishing partnerships between Chinese and German seed and agricultural enterprises. Such activities initiated a platform for future cooperation.

Contact Information for CNSTA:

The China National Seed Trade Association (CNSTA)

Address: 8th Floor Central Tower, ChemsunnyWorld Trade Centre, No. 28 FuxingmenneiStreet, Beijing

Tel: 0086 10 59567950

Fax: 0086 010-5936 9106

Email: cnstaseed@cnstaseed.org

Web: www.cnstaseed.org

5.3 Relevant policies and regulations of the seed industry sector

In order to meet the need to standardize the development of the seed industry, China issued the first national normative document in 1982 – The Trial Implementing Regulations on the Examination and Approval of Crop Varieties. Now, China has formulated a series of laws, regulations and administrative measures based on The Seed Law of the People's Republic of China, which is the legal foundation for regulating and standardizing the seed industry and improving relevant quality safeguards.

5.3.1 The Seed Law of the People's Republic of China

China's first seed law was promulgated in 2000, with previous regulatory framework for the management of the seed industry comprised of the *Regulations of the People's Republic of China on the Management of Seed*, which had been implemented in 1989. The latest *Seed Law of the People's Republic of China*, amended in 2004, 2013, and 2015 respectively, was adopted at the 17th Session of the Standing Committee of the Twelfth National People's Congress and officially entered into force on January 1, 2016. This edition of the Seed Law is divided into ten chapters, listed here in order: 1. General Provisions; 2. Germplasm Protection; 3. Variety Selection and Breeding, Approving and Registration; 4. Protection of New Varieties; 5. Seed Production and Business Operation; 6. Supervision and Administration on Seed; 7. Seed Imports and Exports, and International Cooperation; 8. Supporting Measures; 9. Legal Liabilities; and 10. Supplementary Provisions.

5.3.2 MARA promulgated regulations for implementing the Seed Law

There are four MARA-formulated regulations to support the enforcement of the Seed Law: *Measures for the Administration of Labels and Use Instructions of Crop Seeds* came into effect on January 1, 2017; *Measures for the Administration of the Production and Business Licensing of Crop Seeds* came into effect on August 15, 2016; *Measures for the Approval of Key Crop Varieties* came into effect on August 15, 2016; and *Measures for the Registration of Non-Stable Food Crop Varieties* came into effect on May 1, 2017.

In order to strengthen the monitoring and management of crop gene resources and new crop varieties, China has successively formulated four management measures according to the industry's developmental needs; namely, the *Regulation of the People's Republic of China on Protection of New Varieties of Plants*, *Measures for Management of Agricultural Seed Gene and Genetic Resources*, *Measures for the Approval of Key Crop Varieties* and *Measures for the Registration of Non-main Crop Varieties*. The above management measures were drafted and implemented by the Department of Seed Industry, MARA. See Table 4 for related information and the main contents of each management regulation.

Table 4: Regulations for monitoring main crop varieties

Management Measures	Date of Issue	Purpose of Regulating
Regulation of the People's Republic of China on Protection of New Varieties of Plants	March 1997; last revised in January 2013.	To protect rights in new varieties of plants, encourage the breeding and use of varieties of plants, and promote the development of agriculture and forestry
Measures for the Management of Agricultural Seed Gene Resources	July 2003; last revised in July 2004.	To strengthen the protection of agricultural seed gene resources and promote the exchange and utilization of agricultural seed gene resources

Measures for the Approval of Key Crop Varieties	August 2016	To provide a basis for approving Key Crop Varieties in a scientific, impartial and timely manner. The measures refer to rice, wheat, corn, cotton and soybeans.
Measures for the Registration of Non-Staple Food Crop Varieties	May 2017	To regulate the management and registration of non-staple food crop varieties in a scientific, impartial and timely manner. Excludes staple food crops including rice, wheat, corn, cotton and soybeans

Resource: website of MARA: <http://www.zys.moa.gov.cn/jgzq/>

5.3.3 Reform of procedures for the approval of new crop varieties and promoting the development of the seed market

An accountable new crop variety approval system is an important instrument to guarantee seed quality prior to market entry and is hence an important responsibility of the governmental authority. The Ministry of Agriculture and Rural Affairs is the governmental body that ensures the effective development of the seed market and the quality of commercial seeds in circulation.

Before 2014, the approval of new seed varieties was fully overseen by NATESC, representing MARA. The MARA-driven and unified approval channel ensured seed quality was established before market release; its disadvantage was the constraint imposed on the development of new varieties and market development, since the on-farm trial and testing capacity of NATESC is limited.

Therefore, to promote the development of the seed industry and enable more enterprises to access the seed market, MARA carried out pilots to widen the approval channels in 2014. Besides the unified channel by NATESC, four new paths or channels were introduced (see Figure 27).

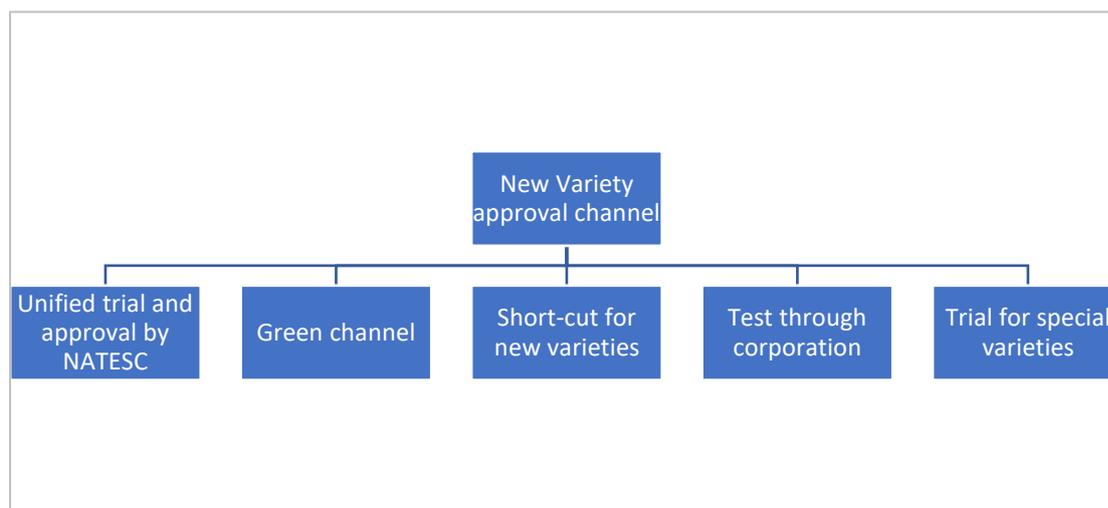


Figure 26: The reformed new variety test and approval channels in China

The new approval system opened four new channels for trialling new varieties which allow large seed companies with integrated capacities for new variety R&D, seed breeding and production, quality-testing experiments and marketing to carry out the quality experiment by themselves. Governmental authorities, i.e., NATESC and MARA, will organize expert teams to monitor the trials, evaluate the results and approve new varieties before releasing them to the seed market.

The new quality testing and approval system greatly accelerated the speed of new variety approvals and caused a massive and rapid expansion of new crop varieties. As a side-effect, the reform enhanced market competition among the seed companies and further fragmented the seed market.

In March 2017, to guide the enterprise-driven testing of new varieties, MARA published its Official Guidelines on Self-Testing the Distinctness, Uniformity and Stability (*DUS*) of Plant Varieties (<http://www.zzi.moa.gov.cn>) and nominated the monitoring and supervising authorities responsible for validating DUS testing results.

5.3.5 Regulations related to the international seed trade

(1) Regulations on the seed trade

At present, China has no specific regulations on the international seed trade, with the relevant regulations instead contained in the Seed Law of the People's Republic of China and other administrative measures promulgated by the Ministry of Agriculture and Rural Affairs. First of all, Chapter VII of the Seed Law regulates "Seed Imports and Exports, and International Cooperation"; second, Article 12 of Chapter III of the Measures for the Administration of the Production and Business License of Crop Seed decrees that the licenses of companies engaged in the import and export of seeds shall be reviewed and approved by the agricultural administrative department of the local provincial people's government, and shall be issued by MARA (other crop seed operation licenses shall be issued by the agricultural administrative department of the local people's government at or above the county level); finally, in terms of the import and export management of genetically modified seeds, detailed management requirements are made in Chapter V of the Regulation on the Administration of Safety of Genetically Modified Organisms in Agriculture.

(2) Regulations on management of gene resource exchange with foreign research institutions

As mentioned above, in October 2003, the former Ministry of Agriculture enacted *Measures on Management of Agricultural Gene Resources*. The regulations clearly stipulated that individuals or research entities who intend to provide gene resources and genetic materials to foreign partners for the purpose of new variety breeding must first prepare an application for approval by the Ministry of Agriculture.

In March 2020, to protect domestic plant gene resources and seed variety property rights, and to regulate research cooperation with foreign institutions, MARA revealed an official circular on *Strengthening the Management of the Exchange of Genetic Resources for Crop Varieties*. The circular set up the procedures of application, review, approval, permit and licensing of this form of research cooperation with foreign research institutions. MARA is the governmental authority for approval and supervision of projects cooperating on the exchange of genetic resources

6. Conclusions and recommendations for Sino-German cooperation in the seed sector

6.1 Summary of findings and conclusions

Compared to the well-established and mature operational seed market system in most developed economies, both the seed industry and market system in China are still at an initial stage of development. After about twenty years' rapid development, the Chinese seed industry and market are both facing the challenge of market fragmentation, severe market competition from large global competitors and large numbers of domestic seed companies. At the same time, opportunities exist for China to further integrate and optimize the market structure through merging the fragmented market actors, further increasing the R&D capacity and financial investment capacity of large domestic producers, expanding the CR and market share of its large seed companies, and enhancing the quality and productivity of its seed companies. Cooperation and joint ventures with international seed companies, rather than attempting to compete with them, can increase the overall market competitiveness of individual Chinese seed companies.

Based on findings from previous chapters, the research team draws the following conclusions on the Chinese Seed Market:

6.1.1 China has a large seed market

- (1) **China has a very large seed market.** With 1.4 billion people, China is the largest food producer and consumer in the world. The average annual grain crop-sown area in China is about 120 million ha, and annual grain production is 650 million tons. To produce this volume of grain crops, China requires about 25.0 billion kg crop seeds per year.
- (2) **The most dynamic and rapid development of the Chinese seed industry and seed market has taken place in the past two decades.** The Chinese seed industry and seed market has undergone four major stages: (i) From 1949 to 1958, individual farmers cultivated small scale farmland and no seed breeding system existed to supply high-quality seed to farmers. (ii) From 1958 to 1982, during the rural collective period, the People's Commune and production brigades set up seed-breeding plots to produce seeds; (iii) From 1982 to 2000, the government controlled the seed-breeding system, with the commercial seed market still not established. (iv) Since 2000, as China joined the WTO and China's first Seed Law entered into effect, the Chinese seed market was opened to international seed companies and the seed industry experienced very rapid development: many enterprises were established, the regulatory and approval procedures, as well as the standards of crop seeds were well-implemented, thus creating an effective policy and regulatory framework for the development of the seed industry in China.
- (3) **Through twenty years of rapid development, China now has the second-largest seed market.** In 2019, the share of the Chinese seed market accounted for 23% of the world seed market. The estimated size of the market for crops in China increased from 14.14 billion USD in 2011 to 19.57 billion USD in 2019, with a compound annual growth rate (CAGR) of 4.73%. With the increase in the commercial rate and market prices of seeds, the average annual growth is about 814 million USD.
- (4) **A large market share of major crop seeds in China.** In 2019, the total crop seed market value was about 137 billion Yuan, of which the share of hybrid corn was 26.7%, at a value of 35.2 billion Yuan,

the largest market share among the three major grain crops. Rice seeds (including hybrid and conventional varieties) had a market volume of 20.2 billion Yuan with a market share of 14.7%; wheat seeds account for 19.6 billion Yuan with a 14.3% market share; potato seeds were valued at 15 billion Yuan with a market share of 10.94%, and soya seeds accounted for 3.2 billion Yuan. Besides these grain crop seeds, approximately 39 billion Yuan (approx. 28.47% market share) was contributed by cash crop seeds and vegetables.

- (5) **The Chinese seed commercial rate still relatively low.** The average commercial rate of grain crop seeds in China is about 70.07%, which is significantly lower than in the USA and in European countries. Among major crops, the commercial rate (CR) of corn and hybrid rice seeds reached 100% with no more potential for increase, whilst conventional rice, wheat and soybean seeds had CRs of respectively 71.24%, 76.14% and 70.38%. The CR of potato seed was approximately 40% with large growth potential. There is still leeway for increasing the CR of most cash crops on the seed market, such as vegetables, fodder crops, flowers and rapeseed.
- (6) **The Chinese seed market is still fragmented and lacks competitiveness.** In 2018, the concentration ratio (CR10) of the whole crop seed market in China was about 18%, the CR10 for hybrid rice and corn seeds was approximately 30-35%, and the CR10 of the wheat seed market was about 20%, all of which were significantly lower than the equivalent CRs on the world seed market. This implies that the Chinese seed market has great potential for increased integration through enterprise acquisitions and mergers. More than 90% of the seed market is populated by more than 5000 small and medium-sized seed companies with very limited R&D and innovation capacity, and which suffer from a shortage of funds for R&D, production and marketing.

6.1.2 The Seed Enterprises in China, their Market Share and Competitiveness

- (1) **A large number of seed enterprises are competing on the seed market.** Stimulated by the preferential seed market policy and opening up of market access, the number of Chinese seed enterprises has swiftly increased over the past ten years. Until 2019, there were 5000 seed enterprises in the Chinese seed market, of which about 98% were small and medium-sized companies with very low R&D capacity and a very small market share. Such market structures lead to vicious market competition, homogenization of seed varieties and a large surplus of seed production, particularly rice and corn seeds.
- (2) **Dynamic mergers in the global seed market and challenges to Chinese seed companies.** Some Chinese seed companies, such as Longping Hi-Tech, China National Seeds Group Co., Ltd, Denghai Seed, Dunhuang Seeds and Win-All Seed (Quanyin) successfully stand out from the market competition through their acquisition of small seed-breeding companies and relevant manufacturing and service companies. However, despite these companies' large R&D and financial investment capacity in comparison to domestic competitors, their market shares are still significantly lower than those of large international companies. In 2018, the top 50 Chinese seed companies occupied about 37% of the domestic crop seed market, whilst international large seed companies such as DuPont+Pioneer (USA), Bayer/Monsanto (Germany), KWS (Germany) and Limagrain (French) occupied and controlled about 70% of the world's seed market, including that of China. These have become increasingly powerful owing to large-scale mergers and joint acquisitions.
- (3) **Opportunities for the integration of the Chinese seed market.** Given the fact that there is a large

number of seed enterprises with limited market competitiveness, there is an urgent need and considerable potential to integrate the fragmented Chinese seed market through approaches which emphasise the benefits of mergers and acquisitions. This also provides opportunities for large international seed companies to participate in the integration of the Chinese market.

6.1.3 Chinese Seed Production, Supply and Demand

- (1) **A large amount of surplus hybrid rice seed.** From 2013 to 2016, the annual surplus of hybrid rice seeds declined from 130 million kg to 80 million kg, whilst from 2016 to 2019, the surplus increased from 80 million kg to 160 million kg. On the whole, there were large surpluses, comprising between one and two-thirds of the annual domestic demand. To absorb the surplus, Chinese companies have started to develop an export market in South and Southeast Asian countries.
- (2) **Overproduction and supply of hybrid corn seeds.** The supply surplus of hybrid corn seeds in China is much larger than that of hybrid rice seeds. In 2013 and 2014, the surplus reached 1 billion kg, which is almost as high as the annual demand. Even in 2016, the year in which the largest land area was planted, the corn seed surplus amounted to more than 500 million kg. Such a high annual surplus in seed supply generated severe competition between different seed-breeding enterprises, negatively affecting profits.
- (3) **The gap between wheat seed supply and demand.** The Commercial Rate of wheat seeds in China is approximately 70% to 80% and hence, there is still a market potential of 20-30% in wheat seeds. The estimated gap for commercial wheat seeds is about 110 million kg/year. Most wheat seeds are conventional varieties; farmers and wheat growers can select and produce seeds by themselves. However, high-yield and high-quality commercial wheat seeds can further increase the productivity and profit margins of wheat growers. In addition, there is also market demand to breed special wheat varieties with special qualities required by particular consumer and niche markets, such as bakery wheat.
- (4) **The supply and demand of vegetable seeds.** China is the largest vegetable producer and consumer in the world. The sown area of vegetables remains at 24 million ha, while the gap between seed demand and supply is about 5000 to 6000 tons, which is currently bridged by imports from the USA, Korea, The Netherlands and Japan. In 2018, China imported 8709 tons of vegetable seeds from these countries, with a total trade value of 228 million USD.

6.1.4 Regulations and Institutions Related to the Seed Market

- (1) In the past 20 years, China has built up an effective governmental and non-governmental institutional and comprehensive regulatory framework to facilitate the rapid development of the domestic and international seed markets.
- (2) The Department of Seed Industry Administration, MARA and NATESC, are two important governmental stakeholders which formulate policies and regulations. They also test and approve new plant varieties.
- (3) CNSA and CNSTA are two seed market and trade-related NPOs supervised by NATESC and MARA. They play important roles in facilitating domestic and international seed market development and Sino-German cooperation in the seed sector.
- (4) China has already set up an effective legal and regulatory framework that underwrites the effective development of the domestic seed market and international trade.

6.2 Recommendations for Sino-German cooperation in the seed sector

In accordance with the abovementioned findings and in consultation with Madam Tian Weihong, Secretary-General of CNSTA, the research team recommends the following measures to strengthen Sino-German cooperation in the seed sector:

- (1) **Carry out Sino-German seed sector policy dialogue.** It is recommended that the seed sector policy dialogue be incorporated into the DCZ Policy Dialogue Platform. Invitations to join policy dialogues will be extended to Chinese seed sector-related governmental authorities and agencies, such as the Department of Seed Industry, NATEC, and other relevant departments of MARA, CNSA, CNSTA. The German Federal Plant Variety Office (Bundessortenamt-BSA) and relevant departments and agencies under BMEL, the German Seed Alliance, the German Plant Breeders' Association (Bundesverband Deutscher Pflanzenzüchter-BDP), the German Agribusiness Alliance (GAA) and the German Export Association for Food and Agriproducts (GEFA), will also be invited to join these dialogues, which will be held at the Sino-German Agribusiness Conference and Sino-German Agriculture Week. Thematic topics for the policy dialogues will be proposed and agreed by partners based on mutual interests. Possible topics include, for instance, a policy framework for the protection of plant variety property rights; international, Chinese and German rules for the seed and variety trade; a policy and regulatory framework for conservation and effective use of plant gene resources; the protection and conservation of plant biodiversity; and the legal system in China, Germany and other EU countries as it pertains to the approval and registration of new seed varieties.
- (2) **Carry out Sino-German seed business dialogue.** It is also recommended to conduct the Sino-German seed business dialogue as part of the DCZ Agribusiness Dialogue Platform. The dialogues will be incorporated into the Sino-German Agribusiness Conference and Sino-German Agricultural Week. Chinese and German seed companies and seed sector-related companies, such as CNSA, CNSTA, the German Seed Alliance, the German Plant Breeders' Association (Bundesverband Deutscher Pflanzenzüchter-BDP), the German Agribusiness Alliance (GAA) and the German Export Association for Food and Agriproducts (GEFA), will be invited to attend these dialogues. Thematic topics of the business dialogues will be proposed and agreed by CNSTA and BDP in consultation with DCZ prior to the events. The seed business dialogue will also serve as a platform to strengthen partnerships between Chinese and German Seed companies.
- (3) **Strengthen Sino-German technical and scientific cooperation in the seed sector.** It is recommended to create a Sino-German Seed Sector Scientific Cooperation Platform. Prospective participants would include Chinese plant breeding institutions, such as the Plant Breeding Institute of CAAS, the Plant Breeding Institute of the Chinese Academy of Sciences (CAS), Faculties of Plant Breeding from Agricultural Universities, and German plant breeding institutions, such as the Society for Plant Breeding (Gesellschaft für Pflanzenzüchtung e.V.- GPZ), the Max Planck Institute for Plant Breeding Research (Max Planck Institut für Pflanzenzüchtungsforschung-MPIPZ), the Leibniz Institute of Plant Genetics and Crop Plant Research (Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung- IPK), and the Julius Kühn-Institute Federal Research Centre for Cultivated Plants (Julius Kühn-Institut Bundesforschungsinstitut für Kulturpflanzen-JKI). The thematic areas for cooperation could be hybrid breeding technology; technology for gene resource conservation; technology for plant biodiversity, exchange of genetic breeding materials; technical standards and procedures for the approval of new varieties; and technical and

procedural toolkit for arbitrating the infringement of plant varieties.

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