Is China on the Brink of Food Crisis?

—China's Food Security, Feed Security and Seed Security

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Introduction

The market and the public have many misconceptions about China's food security. We have prepared this report to show that China is not facing an immediate or long-term threat of food shortages. The government 2021 work report to the National People's Congress once again emphasised the need to ensure food security. In fact, the country's high production capacity in agriculture, along with its ample national reserves, have guaranteed food supplies, particularly in staple grains. Food security is in reality a feedstock problem, because China cannot produce enough feed grains (such as soybeans) to support its large and rapidly growing livestock industry and thus must rely on imports. Price volatility and geopolitical tensions have complicated the international market for feed grains, and driven China to diversify its source countries.

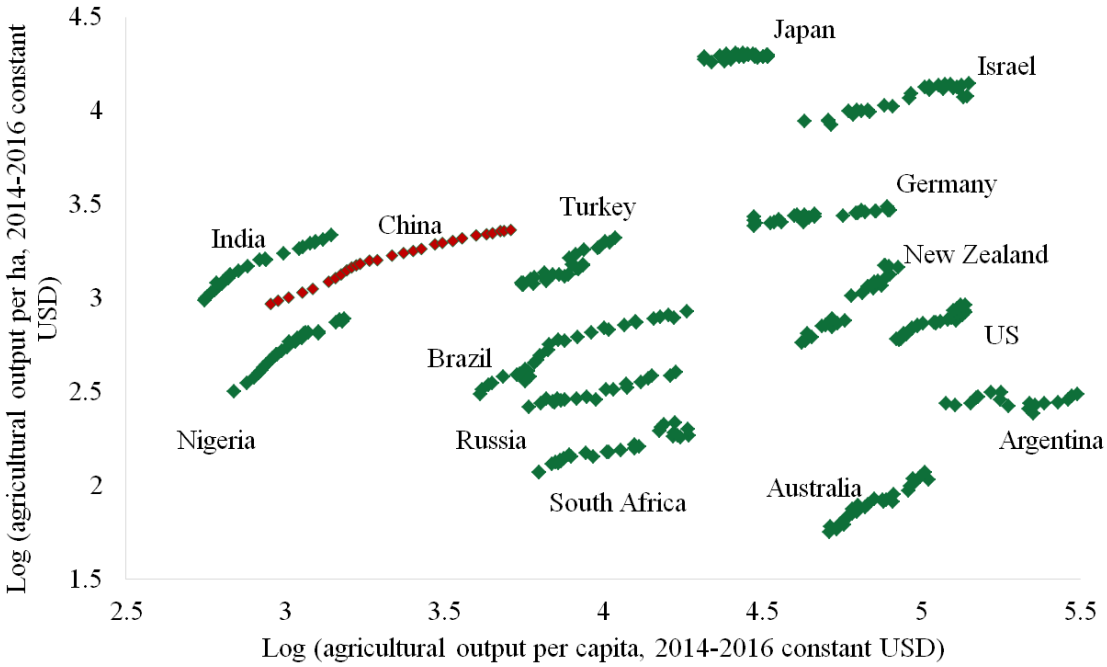
China must also find new ways to improve agricultural productivity. Previously it has successfully done so through market-based reforms in the 1980s and then by intensive use of fertilisers and pesticides. However, the impact of these methods on productivity seems to have reached the limit, and the extensive use of chemical inputs has caused water and soil pollution. The country's next breakthrough in productivity depends on technological innovation. As emphasised in the 2021 No.1 Document (China's top agriculture policy paper, usually published in February each year), seed technology is key to the next stage of agricultural modernisation. Meanwhile, the green development of agriculture will become a critical issue.

This report is organised as follows: section one presents the current status of China's agricultural industry; section two discusses grains supply and their industrial uses such as in the liquor industry; section three explores the role of the international market in China's food supply; section four analyses challenges and opportunities in the seed industry as well as the prospect of genetic modification (GM) technology.

1. China's large and inefficient agricultural sector

Since 1966, China has been the largest agricultural producer in the world. According to the Food and Agriculture Organisation of the United Nations (FAO), China's agricultural output accounted for a quarter of the world's total in 2018, while the next four countries in ranking —the United States, India, Brazil and Indonesia — together only accounted for a fifth of the world's total. China's output of rice, wheat, corn, cotton, vegetables, eggs and pork ranks first in the world; its beef, chicken and milk rank third, and almost all other agricultural products rank in the top ten of global tallies. However, if we look at output per hectare, China still lags behind developed countries, except for its wheat and rice yields.

Land and labor productivity in major agricultural countries, 1991-2018

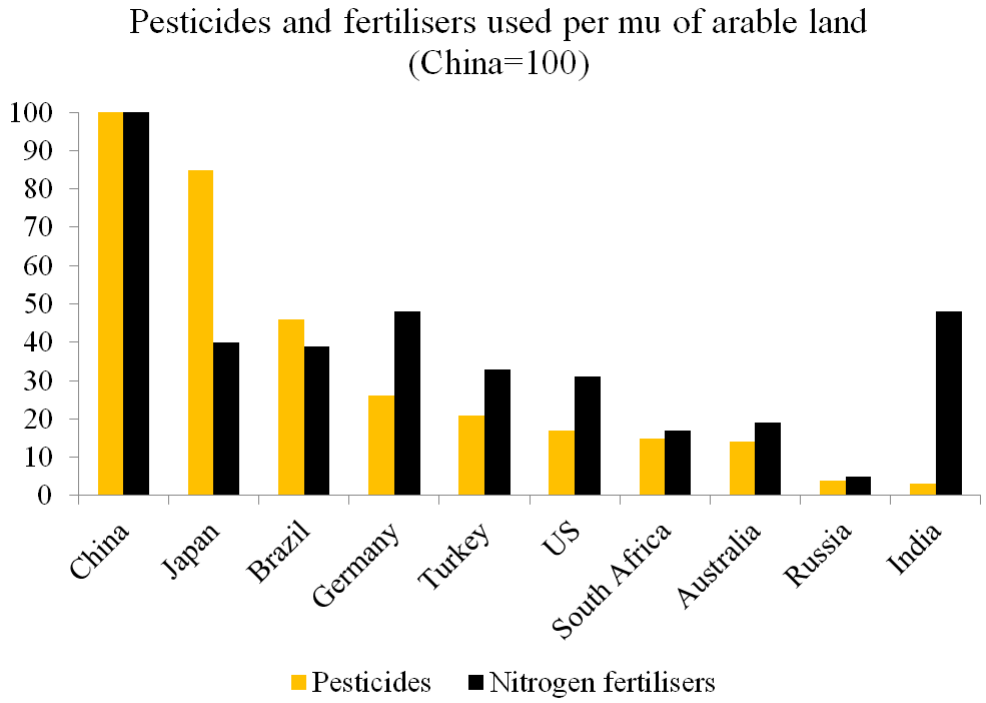


Sources: FAO; World Bank; Hang Seng Bank China.

While still well below that of developed countries, China's agricultural productivity has increased rapidly. From 1991 to 2018, China's agricultural output per capita increased by 6.7% annually, leading the world. This fast pace of growth was the result of the rapid transfer of surplus agricultural labour to cities and the increased mechanisation of farming. However, despite these productivity gains, China has still not achieved its goal of agricultural modernisation. In 2018 more than 26% of the population was still employed in agriculture, but agricultural GDP only accounted for 7% of total GDP. If China is to eliminate the gap between agricultural and non-agricultural incomes, it must raise farmers' incomes through more professional farming practices, and reduce the share of poorly paid, low-value-added agricultural employment.

Yields of grain production had already greatly improved: from 1991 to 2018, the annual growth rate of grain output per hectare was 3.4%. This increase was partly due to the improvement of irrigation facilities and seed quality, but a more significant factor was the wide use of fertilisers

and pesticides. However, since 2015, when the country began to restrict the use of chemical fertilisers and pesticides, the grains yield stopped increasing or even declined. According to the FAO, China is the world's largest user of chemical fertilisers and pesticides, resulting in wide scale water and soil pollution which is difficult to remediate. Since 2015, China's agricultural sector surpassed its industrial sector to become the largest polluting industry in China, according to the Ministry of Agriculture and Rural Affairs (MARA), prompting government restrictions on pesticide and fertiliser use beginning that year.

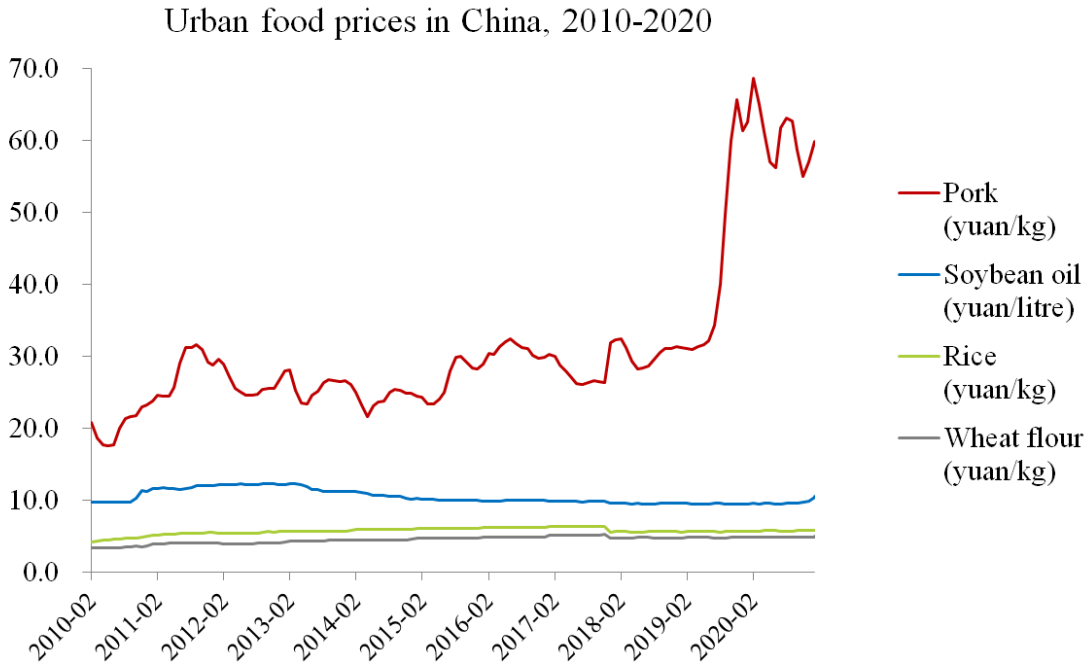


Sources: FAO; Hang Seng Bank China.

Despite the restrictions imposed in 2015, overuse of chemical inputs is still a problem. Statistics reveal that in 2018 China used 25% of the world's fertilisers and 43% of the pesticides. It is not just a question of the volume of inputs, but also the concentration of usage: for every hectare of cultivated land, China uses six times as much pesticide and three times as much nitrogen fertiliser as does the US. In 2020, only 40% of chemical fertilisers and pesticides for crops were applied effectively in China, due to farmers' tendency to overuse in order to enhance output, according to the MARA. Research by the Chinese Academy of Sciences (CAS) in 2018 showed that 21.5% of cultivated land in China had excessive levels of heavy metal pollution, and that such pollution had been increasing over the past 20 years. The pollution in the southern part of China was more serious than that in the north because of more intensive agricultural practices in the south, such as double or triple-cropping. In addition to restricting the use of chemical fertilisers and pesticides, the State Council has also actively promoted organic fertilisers, and proposed in the 2021 No.1 Document to expand fallow land area in 2021 to 40m mu (about 2% of cultivated land). However, due to the universality of pollution, remedial treatment will be a long-term and gradual process.

2. Absolute security in staple grains

Food self-sufficiency is a high priority of China's agricultural policy. In 1996, the central government first announced the national target of 95% self-sufficiency for staple grain crops (rice, wheat and corn), although later requirements have been less stringent and higher import volumes have been permitted. Even after the COVID pandemic, import volumes for the three staple grains made up less than 10% of domestic consumption. The price of agricultural products has also been stable for a long time: in the past 30 years, grain price peaks were only concentrated in the 1990-94 period due to market price reforms introduced at that time for agricultural products. Since the nominal price has hardly changed, the real price of staple grains has indeed dropped due to inflation. The biggest price fluctuation in food has been from pork, especially since the outbreak of African swine fever in China in 2018, which caused pork prices to escalate. By contrast, prices of staple grains remained almost unchanged during the same period.



Sources: NBS; NDRC; Hang Seng Bank China.

China's relatively conservative food policy is based on history and pragmatism. After the founding of the People's Republic of China in 1949, China experienced famine and international blockades, and with a huge population base, food security has always been the government's primary consideration for maintaining social stability. A recent academic study in 2020 showed that one reason for China's famine in 1959-1961 was that in order to repay foreign debts, China's food exports in those years had kept rising despite of food shortage at home. China has been inclined to keep excessive national food reserves while restricting imports, due to concerns that large volumes of grain imports will reduce domestic production and harm farmers' livelihoods. Also, agriculture is constrained by natural resource endowments and growing cycles, so any sudden supply shortages cannot be filled as quickly and flexibly as ramping up industrial production. It is also risky to be over-reliant on the international market to make up any shortfalls: both soybean

and corn cultivation are highly mechanised and thus these grains have greater elasticity of supply, but there is much less flexibility in rice and meat production cycles, so a small increase in demand could lead to a significant price surge for such products.

Among the staple grains, rice is the least traded crop in the international market. Its main production sites are small-scale farms in Southeast Asia, with small land plots and low levels of mechanisation. As rice is the most important staple grain for Southeast Asia, the governments of these countries have committed to a high degree of self-sufficiency in rice cultivation. Although double cropping and hybrid rice have better yields, perceptions are that their taste is inferior to that of the single-season rice crop and thus they are not popular in the market. Occasionally, China has had to import rice to supplement its domestic production: in the mid-1990s, the main rice producing areas in Hunan and Jiangxi experienced reduced rice harvests, and as these two provinces mainly supplied Guangdong, Guangdong was forced to import rice from the international market, resulting in soaring global rice prices.

Consumption, self-sufficiency rate and national reserves of major agricultural products in China, 2020

	Consumption (kg/capita)	Self-sufficiency rate	National reserves can support consumption for (month)
Wheat	79	93%	13
Corn	59	92%	8
Rice	106	98%	9
Pork	31	88%	9
Cotton	28	72%	11
Soybean	13	15%	3
Sugar	11.0	72%	-
Beef	6.6	71%	-
Sorghum	7.8	30%	-
Rapeseed	6.2	75%	-
Fruit*	198	98%	-
Vegetable*	495	99.9%	-

Note: *Fruit and vegetable data are from 2019.
Sources: USDA; NBS; Ministry of Commerce of China; Hang Seng Bank China.

During the COVID crisis, anxious consumers and firms rushed to hoard all kinds of food supplies. Meanwhile, the central government also emphasized the need to conserve food, which many regarded as confirmation that there were indeed food shortages. Yet this panic was groundless. In 2020, even as the pandemic affected normal agricultural production schedules, grain output hit a record high, reaching 670m tonnes. The grain output per capita thus increased to 478 kg, which is 78 kg higher than the international basic food safety line of 400 kg per capita. Moreover, China has ample stockpiles of grains. The national stockpiles of wheat, rice and corn can support domestic

consumption for thirteen, nine and eight months respectively, which is much higher than the generally accepted international level of 3-6 months' supply for food security.

Ironically, a bigger problem for staple grains in China is in fact managing the high level of national reserves. The market is generally not interested in the auction of excess grain reserves, because Chinese domestic prices are higher than international grain prices. The price difference is mostly due to the high cost of labour and land for domestic production. Reducing corn reserves is relatively easy as the crop has a wide range of industrial uses. China's corn stocks were high around 2017, but because the government encouraged the development of bio-energy fuel, corn stocks were rapidly depleted. It is more difficult to destock rice and wheat reserves as there are fewer industrial uses for these grains. Considering rising storage costs and quality deterioration following prolonged storage, in the future grain reserves may need to be gradually decreased according to a managed schedule, or new uses may need to be developed to draw down excessive reserves.

There are some noteworthy trends in industrial grain usage in recent years. Apart from corn being used as bio-energy fuel, industrial use of grain is mostly concentrated in liquor production, seasonings and pharmaceuticals, and development of these three industries has accelerated after the pandemic. Liquor production consumes the most grain because, unlike Western grape-based wine production, grain-based liquor is the mainstay of the Chinese market. One liter of 65-degree liquor consumes about 3 kg of grain, while beer consumes 0.2 kg of grain per liter. In 2020, the output of liquor and beer reached 6.3bn liters and 30.8bn liters respectively, utilizing 25m tonnes of grain, accounting for 3.7% of the total grain output that year. This ratio is far lower than the peak of 7.4% reached in 2012, when there was a much higher demand for liquor. Liquor consumption was greatly reduced by anti-corruption campaigns after 2012, but it seems to have made a comeback in recent years as the rising middle-class increasingly favours Chinese liquor. There is some concern that staple grain stocks diverted to alcohol production will hurt food security, but in fact such raw material accounts for only a small percentage compared to sorghum, which is a key ingredient in alcohol manufacturing but which is not considered sensitive for food security. In the next few years, rising income levels will further increase the demand for sorghum-based liquor, especially high-end brands. Brewing firms have set up dedicated sorghum production bases to supply this demand, and the governments of Guizhou, Sichuan, Liaoning and Anhui all have specific plans to expand local breweries and distilleries to promote the development of their respective alcohol industries and alleviate poverty.

Food waste in China is alarming, although not enough to threaten food security. The CAS and the Chinese Academy of Agricultural Sciences (CAAS) have different estimates but their findings assess grain losses at about 5-10% of China's grain output, and this growth is accelerating. In addition to food waste in catering, there are also losses due to long-distance transportation, storage and processing of grains. Although such losses can be reduced by high-tech means or better management, such costs will be high and improvements are likely marginal. Moreover, although the cumulative amount of wastage is huge, the waste sites and processes are scattered, making it difficult to amass or repurpose the grains. Besides saving food, China has easier ways to ensure food supply, such as different types of farming practices. A typical example is the flexibility of rice planting, easily calibrated to meet market demand although the taste may be compromised to a degree. Previously, Jiangxi and Hubei had switched from double-cropping rice harvests to single-season rice cultivation so as to increase rice quality and to facilitate raising crayfish in the off-

season flooded rice fields for added cash value; after the pandemic, in order to ensure rice output, they changed back to double-cropped rice, which increased the summer grain harvest above forecast, stabilizing the market.

With increased urbanisation and dietary changes, the per capita demand for staple grains will decline, while the demand for meat and aquatic products will rise. According to CAS, the per capita staple grain demand of urban residents is 15% lower than that of rural residents. For every 1 percentage point increase in the urban population, the total grain demand will drop by 570,000 tonnes (about 1% of the output in 2020). China's urbanisation rate is now 60%, and the official target is to reach 70% in ten years. Based on this forecast, the correlating demand for staple grains in 2030 will be 10% less than it is now. Therefore, whether it is short-term or long-term, China can guarantee the security of its staple grains supply.

3. Taking advantage of global resources

Although the priority of self-sufficiency in staple grains will remain, it will be too expensive to ensure self-sufficiency in all foods, since the costs of labour and land have been rising. Another factor that cannot be ignored is that freshwater resources are particularly scarce. China's agricultural sector is the largest water user in the national economy, consuming 60% of the country's freshwater resources. In contrast, industrial and residential sectors only use 20% respectively. At present, China has basically liberalised the import of soybeans, sorghum, rapeseed, palm oil and rubber, while implementing import quota management for cotton and sugar. Corn, as one of the three staple grains, is under strict quota management, but its import has been on the rise. By selective imports of these agricultural products, China has preserved land and freshwater resources at home.

Price trends of four major crops (yuan/tonnes)

Sources: Ministry of Agriculture and Rural Affairs of China; National Grain and Oil Information Center; Chicago Mercantile Exchange; National Bureau of Statistics of China; Wind; Hang Seng Bank China.
Notes: The Chinese prices of the four crops are wholesale market prices. The US prices of wheat, corn and soybeans are the CME futures settlement prices. The Vietnamese rice price is FOB price.

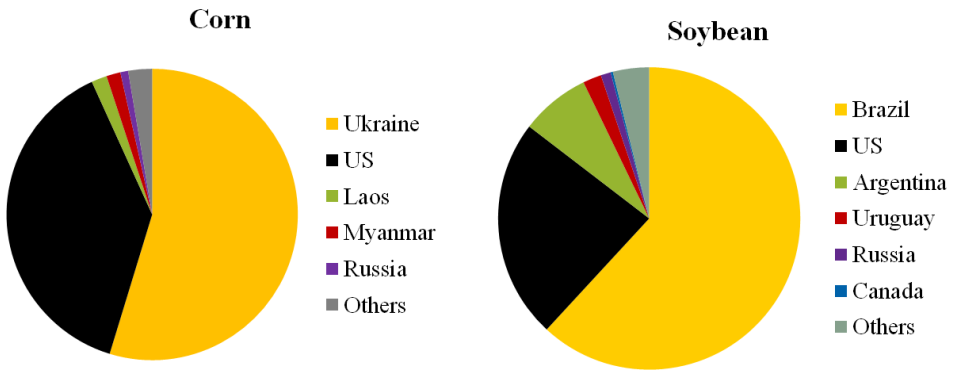
However, even if imports are liberalised, China will maintain its key specialised agricultural production areas, such as cotton fields in Xinjiang, soybeans in Northeast China, sugar in Yunnan and rubber forests in Hainan, regardless of the cost. The primary reason for keeping such farms is local employment---they are in some of the poorest regions in China---while maintaining a minimum level of self-sufficiency. Due to low productivity and high input expenditures, China's grain production cost is generally higher than the international level, which explains why the difference between domestic and foreign grain prices has consistently remained high. In the past

five years, the domestic price of wheat, rice, corn and soybean was 110%, 90%, 115% and 80% higher than the respective international prices on average. Even considering the tariff (usually 3%) and value-added tax (usually 13%) of imported agricultural products, these price differences are still alarming.

In order to incentivise farmers to grow staple grains, the central government subsidises every step of the cultivation cycle, from planting to harvesting, which makes China the largest agricultural subsidiser in the world. Ironically, this also causes volatility. Because the subsidy budget is always limited, the allocation varies every year, which affects the stability of food production. Farmers switch their planting to the crop with the highest subsidy in a given year, even if the local soil is not suitable for sowing this crop. This leads to excessive water use and land degradation. In addition, the high price differential between local and global production encourages food smuggling, especially between border markets, such as rice smuggling from Vietnam and pork from Russia (some people believe that this is how the African swine fever entered China in 2018).

Feed grain accounts for the highest percentage of legal agricultural imports. In 2020, soybean imports reached 100m tonnes, accounting for 85% of domestic consumption. Corn imports reached a record high of 24m tonnes, exceeding the import quota for the first time in history (the quota is 7.2m tonnes for corn; the tariff is 1% if imports are below this level but will jump to 65% for the excess). Even sorghum imports have doubled in 2020, because sorghum can be used as a substitute for other feeds. The huge demand for feed grain comes from the expansion of the pork industry, and this trend shows no signs of slowing down. Herd totals of live pigs have not recovered to their levels before African swine fever: by end-2020, the stock level of live pigs was only 92% of that in 2017 (African swine fever started in the second half of 2018, so 2017 was the last normal year). The investment from enterprises and farmers in restocking and expanding pig farms is still increasing, but to fill the demand gap, pork imports soared by 110% in 2020.

China's source countries for corn and soybeans in 2020



Sources: China Customs; Hang Seng Bank China.

China's food security problem is mainly a problem of feed grain. Policy makers are determined to meet the huge domestic meat demand, but they are also aware of China's complex relationships with major feed producing countries. Volatility in the international market has increased due to geopolitical risks. China's import of agricultural products has been the focus of debate amid US-China trade tensions. In the beginning of the trade dispute, China's soybean imports from the US

had been substituted by shipments from Brazil and Argentina. However, after signing the Phase One trade agreement, China made a commitment to purchase a large volume of agricultural products from the US. Accordingly, some Chinese soybean purchases were redirected to the US.

It is unrealistic to rebuild feed grain production capacity in China to achieve self-sufficiency. Several previous attempts have had little effect because China is constrained by its water and land endowments. However, the international market, especially countries along the " Belt and Road Initiative" (BRI), still has the potential to increase yields of soybeans and corn in order to meet China's demand. In addition to securing external supplies of soybeans and corn, China could also expand its domestic grass-based animal husbandry, such as raising cattle and sheep. Constrained by land shortages, only a few provinces, such as Inner Mongolia and Qinghai, have the potential to develop large-scale pasture farms. Yet their growth potential, starting from a low base, remains significant. The herds are fed forage plants like silage and alfalfa, which remain under-developed in China. Due to its strong regeneration ability and ecological worth, it is likely that grassland farming will attract more investment in line with China's transition to a greener economy.

China has realised the importance of utilizing international resources and made great efforts to expand its agricultural overseas direct investments (ODIs) in the past decade. Chinese agricultural investment strategy has gradually transitioned from directly buying land for grain cultivation or holding shares in local farms to controlling the whole process of production, logistics and trade. Some BRI countries, such as Russia, Kazakhstan and Ukraine, have large farm holdings but low productivity. China has been able to improve local grain yields through technical cooperation and then export the harvest to China. China's international projects also include investment in small-scale rice plants in Africa (such as introducing the production of Green Super Rice, a high yield variety developed by China, in Mozambique), and large-scale soybean plants, processing facilities and ports in Brazil and Argentina.

China's agricultural ODI has slowed sharply in recent years, from its peak growth rate of 45% in 2012 to only 5% in 2019, and at present the agricultural ODI stock only accounts for less than 1% of China's total non-financial ODI. This reflects the long-term and complex nature of agricultural investment. Operating overseas is highly risky especially when the timeframe for a return on capital is long. For this reason, private investors are usually not interested in such projects, leaving state-owned enterprises to take the initiative. Developed countries have stricter review standards for environmental protection, while emerging market economies have increased restrictions on foreigners buying arable land and taking stakes in domestic agricultural investments. Post-COVID, all countries are likely to strengthen agricultural protectionism, bringing additional challenges to future overseas investment by Chinese agricultural interests.

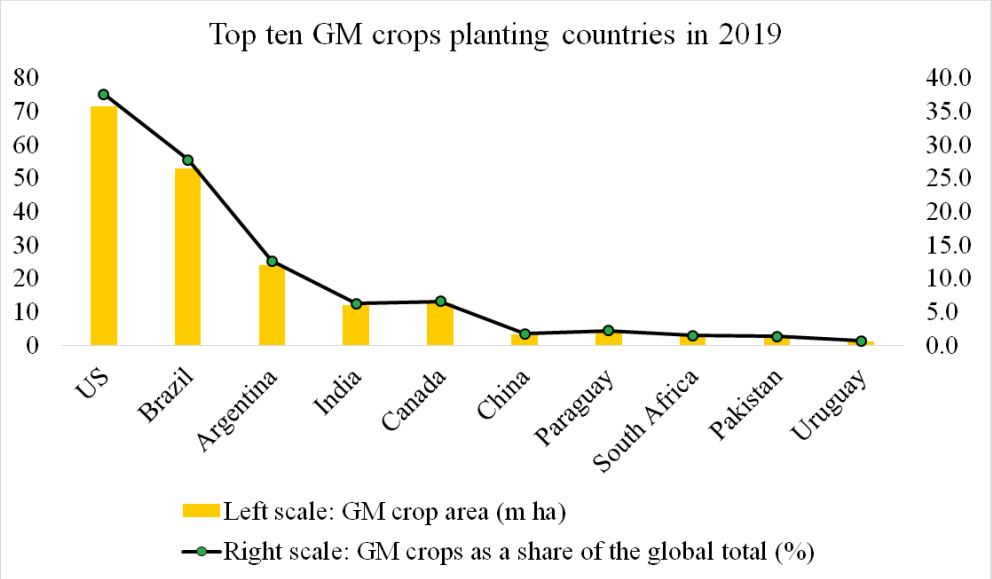
China is the world's largest importer of agricultural products and an important exporter of agricultural products. In 2019 China's agricultural export value was US$78.6bn, which accounted for 7.1% of the total agricultural output value, ranking fifth in the world (FAO, NBS). Grain exports accounted for only 1.4% of agricultural exports, indicating that grain production is mainly to meet domestic demand. The main export goods are aquatic products and vegetables, which together accounted for half of the agricultural export value, with the rest being mostly tea, fruits and meat products. The export of these high value-added goods helps to provide agricultural employment and increase farmers' income, but international agricultural trade is vulnerable to political risks. For example, as the China-US relations deteriorate, the US banned in 2021 the import of cotton

and tomato products from Xinjiang. Previously, with rising protectionism, Chinese agricultural exports were once embargoed in South Korea, Japan and a few other countries. Agriculture is a highly sensitive political issue in almost all countries, so trade disputes are often first reflected in restricting agricultural trade. This is one reason why China's agricultural exports has been growing slowly (in the past five years, the average annual growth rate was only 2%). Except for a few coastal provinces such as Shandong, Fujian and Liaoning, the agricultural exports in other regions is small.

4. Seed security

China's 2021 "No.1 Document" prioritised the development of the seed industry for the first time, stating that "seeds are the foundation of agricultural modernisation". This strategy is comparable to the national policy guiding the development of China's indigenous micro-chip industry, which is aiming for an integrated, self-sufficient supply chain. In the case of agriculture, the strategy envisages Chinese crops all originating from Chinese seeds. In fact, China already has a high rate of self-sufficiency in seeds. The seeds of rice, wheat, corn and soybean are basically sourced in China. In contrast, vegetable seeds rely on foreign supplies, but this is a global trend and China is no exception. What's more worrying is that livestock industry also relies on foreign germplasm, including breeding pigs and cattle that need to be imported from Australia or Europe at high prices. As such, the 2021 government work report of the Two Sessions emphasised protecting China's native germplasm resources to reduce the dependence on foreign technologies.

China's indigenous seed industry remains at a preliminary stage of development, and is dominated by small and medium-sized firms. The intellectual property for seeds is severely under-protected, so counterfeit seeds are common. This has hurt research, investment and innovation efforts in the local seed industry. By the end of 2018, there were 5,663 companies with valid seed production licenses in China. However, the sales of commercial seeds from the top five companies of this group only accounted for 12% of the entire country's seed market, in sharp contrast to the highly centralised seed markets in developed countries. The global seed industry is capital-intensive, relying heavily on high R&D investment. It is difficult for small, fragmented firms to make technological breakthroughs, and it is also challenging for effective government supervision.



Sources: ISAAA; Hang Seng Bank China.

Genetic modification (GM) is the most important biotechnology in the seed industry. Selective genes are separated by genetic engineering in the laboratory, and then inserted into the genetic structure of a receptor seed, so that the modified seed will show different traits from the original species, such as drought resistance and insect resistance. China has invested heavily in the

research and development of GM varieties of animals and plants. From 2008–to 2020, the total national investment was Rmb24bn, but these investments have been confined to research without reaching commercialisation and broader applications.

The main reason why China's GM industry is stagnant has been the opposition from consumers. Whether in urban or rural areas, and regardless of educational level, the Chinese public mostly opposes GM foods. In 2013, a well-known Chinese TV producer filmed a documentary on GM foods in the US, which sparked a national debate on whether GM food is safe to eat. Domestic reports on GM foods were misleading, using alarming titles such as "Americans don't eat GM foods" and "eating GM foods affects fertility", but these false reports had a widespread negative impact on consumers. Up until now, there is no scientific evidence that the consumption of GM food is harmful to humans. Meanwhile, using GM seeds can reduce the use of chemical fertilisers and pesticides, which would be beneficial to human health. In recent years, Chinese consumers' awareness of GM technology has increased, but their acceptance is even lower than before. In 2016, only one quarter of Chinese consumers had a positive view of GM. Those living in big cities, who are better educated and older tend to reject GM. Men's acceptance of GM is slightly higher than women's.

Opposing GM is not a uniquely Chinese phenomenon, as it is one of the most controversial technologies anywhere. Yet despite the fierce debate on whether it is safe to eat GM foods, the planting area of GM crops is growing rapidly in the world: in 2019, the global planting area has increased to 190m hectares, accounting for 14% of global arable land. GM soybean cultivation is the largest of all, with the planting area accounting for 48.3% of all GM plants. As GM represents the highest level of biotechnology, all countries have government funds backing its research, even if public acceptance of GM varies from country to country. By 2019, in total 29 countries have commercialised the planting of some GM crops. According to CAS, consumers in the US, Canada and Latin America are more inclined to support GM, but European and Japanese consumers are reluctant to accept it.

China has only commercialised the planting of GM cotton and papaya. Although GM tomatoes, sweet peppers, morning glory, insect-resistant rice and corn have acquired Chinese safe production certificates, they are not yet allowed to be planted in China. However, it is not uncommon for Chinese farmers to use GM seeds surreptitiously. According to a research by the Chinese Academy of Sciences in 2019, about 43% of farmers in Jilin and Liaoning were using GM corn seeds. Because the local soil condition is prone to insects, the insect-resistant GM seeds had much better yields and thus were welcomed by farmers. These seeds came from Monsanto, a US biotech company, and entered the Chinese market through illegally operated seed companies. Thus China's ban on GM corn seeds is actually not stringently enforced. Many agricultural experts believe that corn will be the next GM crop that will be authorized for commercial cultivation in China, so they have invested in related research. China's leading agricultural firms, such as Dabeinong Technology and Longping High-tech have collaborated with Zhejiang University in researching GM corn seeds. Once commercialisation is allowed, the planting area of GM corn will expand rapidly.

For average consumers, their probability of indirect consumption of GM food is high, regardless of their attitudes towards the technology. All imported soybeans in China are used as feedstock for animals or to make cooking oil, as they are not authorised for direct human consumption. In

contrast, soybeans produced in China (accounting for only 15% of domestic consumption) are all non-GM crops, and can be directly consumed or made into foods like tofu. Imported corn, rape seed and beets are almost all GM crops, but are only used in food processing industries (for feed or biofuel) and are not allowed to be consumed directly.

Chinese firms once hoped to improve domestic seed research capabilities through acquiring overseas companies, such as Sinochem's acquisition of Syngenta and Longping High-Tech's acquisition of Dow's corn seed business in Brazil. However, with the deterioration of China-US relations, the US and its allies began to restrict China's acquisition of their high-tech firms, including biotech firms. Therefore, China has responded with its "dual circulation" strategy of self-sufficiency, hoping to leverage its domestic resources to support local innovation by firms, universities and other research institutions.

In the past 40 years, China had made two great advances in agricultural productivity: the first was driven by the market-based agricultural reforms in the 1980s (the household responsibility system), and the second by the widespread use of chemical inputs such as fertilisers and pesticides. However, the impact of these productivity gains seems to have reached its limit. China's next agricultural productivity breakthrough must rely on scientific innovation, and seed technology is the key. Although more scientific evidences are needed to determine whether GM has a long-term harmful impact on human body and the environment, the commercialisation of more GM foods will likely to accelerate.

Developing GM technology is economically pragmatic from the perspective of stabalising food production. China is prone to agricultural diseases and pests, such as fall armyworm, locusts and cotton bollworms, which can easily threaten crop production if not handled carefully. GM seeds are expensive, but they can improve yields while resisting pests and deadly virus. According to CAS studies, GM cotton and corn can more than halve the use of pesticides while increasing yields, and GM papaya can resist ringspot virus (a virus that threatens the extinction of papaya). With the exception of the pesticide and fertiliser industries, which would see its sales decline, all other stakeholders stand to benefit from GM technology, including consumers, farmers, feed processing companies and agricultural services industries.

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