

Outlook for China Glyphosate Industry 2023–2027

The Fourteenth Edition

May 2023

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Kcomber Inc.

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Executive summary

Glyphosate, the key active ingredient of Roundup, is one of the most commonly sold herbicides on the market today. With rapidly increasing demand, glyphosate has shared about 30% of the global herbicide market in terms of sales volume.

- Position of Chinese glyphosate in the world

China is the largest production base of glyphosate technical in the world and has been supplying over 70% of the global production of glyphosate. The output of glyphosate TC was about 595,000 tonnes in 2022 (converted to 95% technical), over 45% of which was exported.

- Production

The domestic output of glyphosate technical increased greatly from 512,000 tonnes in 2013 to 600,000 tonnes in 2016, and since 2017, it has fluctuated around 600,000 tonnes.

Glyphosate production adopting the AEA pathway remains dominant in China, with its output reaching 450,000 tonnes and taking up 75.6% of national total in 2022.

In the past few years, the domestic production of glyphosate technical tended to transfer from East China to Central China (Hubei Province) and Southwest China (Sichuan Province), and North China (Inner Mongolia Region). The output of glyphosate technical in Sichuan, Hubei, and Inner Mongolia increased from less than 100,000 tonnes before 2012, to over 340,000 tonnes in 2022.

The number of glyphosate technical producers in China (both active and idle are included) declined from over 45 in 2014 to only 16 in 2022, which was caused by stricter environmental protection requirements and fierce competition.

Chinese glyphosate industry is dominated by the companies that own the latest technology, large-scale production capacity, strong financial and sales strength and a complete industrial chain, etc. Leading producers of glyphosate technical in the country include Fuhua Tongda (153,000 t/a), Hubei Trisun (130,000 t/a), Zhejiang Wynca (80,000 t/a), Nantong Jiangshan (70,000 t/a), Jiangsu Good Harvest (62,000 t/a), Leshan Hebang (50,000 t/a glyphosate technical, 180,000 t/a PMIDA), Jiangsu Yangnong (35,000 t/a), etc.

- Export

Glyphosate is one of the largest export commodities in the pesticide sector in China regarding both volume and value, China's glyphosate industry highly depends on the overseas market. Besides, China is the largest exporter of glyphosate in the world.

The major export destinations of Chinese glyphosate technical are Argentina, the US, Brazil, Malaysia, Indonesia, Australia, and Russia, and the major destinations of glyphosate formulations are Australia, Vietnam, the US, Ghana, Nigeria, Russia, Brazil, Uruguay, the Philippines, Japan, Mexico, Indonesia, Ukraine, etc.

The main exporters of glyphosate formulation in China include Xingfa (Shanghai) International Trade Co., Ltd., Shandong Weifang Rainbow Chemical Co., Ltd., Zhejiang Wynca Chemical Industrial Group Co., Ltd., etc. The main exporters of glyphosate technical in China include Fuhua Tongda Agro-Chemical Technology Co., Ltd., Nantong Jiangshan Agrochemical & Chemicals Co., Ltd., etc.

- Demand

Glyphosate has taken an irreplaceable position in the control of weeds in China, and its consumption grew at a CAGR of 7.4% in 2013–2022, reaching about 124,000 tonnes (converted to 95% technical) in 2022.

In China, glyphosate is quite important for the weeding in orchards, vegetables, wasteland reclamation and traditional crop fields in the period of pre-seeding. Orchard is the largest consumption field of glyphosate, with a demand share of about 35.3% in 2022, followed by vegetables, corn, rice, wheat, tea, rubber, etc.

- Production technology

There are two pathways for glyphosate production in China including the iminodiacetic acid (IDA) pathway and the aminoethanoic acid (AEA) pathway. According to the starting raw material, the former can also be subdivided into two routes, namely the diethanolamine (DEA) route and the iminodiacetonitrile (IDAN) route.

The IDA pathway had been developing rapidly in 2005–2009, and many domestic companies set up glyphosate technical production lines adopting the IDA pathway, especially the IDAN route. After that, the DEA route showed a downtrend with the number of producers decreasing from 10 in 2009 to only 1 in 2022 because of the strong competitiveness of the IDAN route stemming from its advantages such as low cost, sufficient IDAN supply, etc.

The AEA pathway is widely adopted in China's glyphosate industry. In 2022, the capacity of glyphosate technical by this pathway was about 578,000 t/a, accounting for 69.6% of China's total capacity.

- Price

The annual average ex-works price of 95% glyphosate technical kept decreasing, from USD4,066/t in 2018 to USD3,254/t in 2020, and then rebounded significantly, reaching USD9,542/t in 2022.

Methodology

The research for the report is carried out by the following steps:

-Desk research

The sources of desk research are various, including published magazines, journals, government statistics, industrial statistics, customs statistics, association seminars as well as information from the Internet. A lot of work went into compiling and analyzing the information obtained. Where necessary, checks were made with the Chinese suppliers regarding market information such as production, demand, use, competition, etc.

-Telephone interview

The interviewees cover:

- Producers
- Agricultural experts
- Traders
- Local governments
- Researchers
- Associations
- Equipment suppliers
- Raw material suppliers

CCM carried out extensive telephone interviews with all manufacturers of glyphosate technical and PMIDA producers as well as some producers of glyphosate formulations. Detailed production information and market situation were sourced and verified. Furthermore, players' comments on glyphosate industry were obtained.

For directly analysing the imports and exports of glyphosate technical, its formulations and PMIDA, many importers and exporters were contacted whenever the verification was needed.

Raw material (glycine, DEA, IDAN, PMIDA, etc.) suppliers were also contacted to help understand the price, supply as well as governmental policies on raw materials and their impact on the glyphosate industry.

-Export analysis

Analysis of export data (HS code 29313910, 29313990, 38089311 and 38089319) from the China Customs helps work out China's exports of glyphosate (glyphosate technical, glyphosate formulations and PMIDA) by producer, trader and destination.

-Data processing and presentation

The data collecting and compiling are sourced from:

- Published articles from Chinese periodicals, magazines, journals, the third-party database
- Government statistics & customs statistics
- Telephone interviews with Chinese producers, traders, governments and farmers
- Comments from industrial experts
- CCM's database
- Professional database in other sources
- Information from internet

The data from various ways have been combined to make this report as precise and scientific as possible. Throughout the process, a series of internal discussions took place in order to analyse the data and draw conclusions from it.

-Report generation

Logical analysis and scientific ratiocination were conducted to generate the report, such as supply & demand analysis and cross-checking of all data. All the data and findings obtained through the above methods will be presented in the report clearly.

-Glossary

In this report, there are many abbreviations for formulation type and glyphosate-related products, including various glyphosate formulations, glyphosate technical, intermediates/raw materials, etc. They are listed as follows:

AEA: aminoethanoic acid (glycine)
IDA: iminodiacetic acid
IDAN: iminodiacetonitrile
DEA: diethanolamine
HCN: hydrocyanic acid
DMP: dimethyl phosphite
PCL3: phosphorus trichloride
PMIDA: N-(phosphomethyl) iminodiacetic acid
IPA: isopropylamine
AI: active ingredient
SP: soluble powder
SL: soluble concentrate
WSG: water soluble granule
CAGR: compound annual growth rate
COD: chemical oxygen demand
BOD: biochemical oxygen demand

If not specified, glyphosate tech. (technical) in this report refers to glyphosate acid with a content of 95%, and glycine refers to industrial grade (tech-grade) glycine with a content of 95%.

-Unit

RMB: currency unit in China, also called yuan
USD: currency unit in the US, also called US dollar
Tonne: equals to metric ton in this report
/t: per tonne
t/a: tonne/annual, tonne per year
t/d: tonne per day

Note: As for the export data in this report, the export volumes in tonne were converted from those in kg and then rounded, influencing by this, totals in the tables may slightly differ from those calculated without decimal places.

Table 1 Regions covered

Regions covered (Chinese mainland)	Name
Province (22)	Heilongjiang, Jilin, Anhui, Fujian, Liaoning, Hebei, Shandong, Gansu, Qinghai, Henan, Sichuan, Jiangsu, Hubei, Hunan, Jiangxi, Zhejiang, Guangdong, Shaanxi, Hainan, Shanxi, Guizhou, Yunnan
Autonomous region (5)	Guangxi, Inner Mongolia, Tibet, Xinjiang, Ningxia
Municipality (4)	Beijing, Shanghai, Tianjin, Chongqing

Source: CCM

Table 2 USD/CNY exchange rate, Jan. 2012–May 2023

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
2012	6.3168	6.3000	6.3081	6.2966	6.3062	6.3178	6.3235	6.3404	6.3395	6.3144	6.2953	6.2900	6.3136
2013	6.2787	6.2842	6.2743	6.2471	6.1970	6.1718	6.1725	6.1708	6.1588	6.1393	6.1372	6.1160	6.1920
2014	6.1043	6.1128	6.1358	6.1553	6.1636	6.1557	6.1569	6.1606	6.1528	6.1441	6.1432	6.1238	6.1428
2015	6.1272	6.1339	6.1507	6.1302	6.1143	6.1161	6.1167	6.3056	6.3691	6.3486	6.3666	6.4476	6.2288
2016	6.5527	6.5311	6.5064	6.4762	6.5315	6.5874	6.6774	6.6474	6.6715	6.7442	6.8375	6.9182	6.6425
2017	6.8918	6.8713	6.8932	6.8845	6.8827	6.8019	6.7772	6.7148	6.5909	6.6493	6.6300	6.6067	6.7662
2018	6.5079	6.3045	6.3352	6.2764	6.3670	6.4078	6.6157	6.8293	6.8347	6.8957	6.9670	6.9431	6.6070
2019	6.8482	6.7081	6.6957	6.7193	6.7344	6.8896	6.8716	6.8938	7.0883	7.0726	7.0437	7.0262	6.8826
2020	6.9614	6.9249	6.9811	7.0771	7.0690	7.1315	7.0710	6.9980	6.8498	6.7796	6.7050	6.5921	6.9284
2021	6.5408	6.4623	6.4754	6.5584	6.4895	6.3572	6.4709	6.4660	6.4680	6.4604	6.4192	6.3693	6.4615
2022	6.3794	6.3580	6.3014	6.3509	6.5672	6.6651	6.6863	6.7467	6.8821	7.0992	7.2081	7.1225	6.6972
2023	6.9475	6.7492	6.9400	6.8805	6.9054	-	-	-	-	-	-	-	-

Source: The People's Bank of China

1 Factors influencing China's glyphosate industry

The development of China's glyphosate industry is influenced by the following factors:

- Domestic government policy
- Global and domestic economic environment
- Crop planting situation
- Global demand for glyphosate
- Raw material supply
- Technology level
- International market competition
- etc.

Among the above factors, global demand for glyphosate plays the most important role. Government policy will also take on an increasingly significant part in the future. Other factors, such as crop planting, have less impact on China's glyphosate industry.

Table 1-1 Influencing factors of China's glyphosate industry, 2022

Item		Analysis
Favourable factor	Fast-growing GDP	China's GDP growth is faster than the global average, which will assure the domestic glyphosate industry and its related industries of a good environment.
	Low labour cost	There's abundant qualified labour in China and the labor cost is low.
	Increasing farmers' income	Rising income means farmers have stronger purchasing power.
	Rising demand for glyphosate globally	This is also applicable to China itself. More GM crops, larger no-tillage land and crop planting area will stimulate the demand, thus promoting glyphosate's development in China.
	Low production cost	Production cost in China is lower than the global average.
Unfavourable factor	Oversupply	Overcapacity in China's glyphosate industry has led to a long-term gloomy glyphosate market and undervalued glyphosate prices.
	Inefficient formulation technology	The glyphosate formulating technology is inefficient in China.
	Policy on export	The export rebates for glyphosate and PMIDA have been cancelled.
	Costly registration abroad	The cost of registration is unaffordable for most Chinese enterprises.
	Low brand recognition overseas	The domestically made products are exported at low prices, due to the low recognition overseas.
	Higher environmental cost	Domestic glyphosate producers invest much more in waste treatment and by-product recovery.

Source:CCM

1.1 Economic environment

- Stable economic development in China

China's economy has been continuously developing with a stable growth rate. The country is gradually turning from a world manufacturing centre into a large consumer of all kinds of products. Stable economic growth will ensure the stable development of the domestic pesticide industry including glyphosate.

Figure 1.1-1 China's GDP growth, 2013–2022



Source: National Bureau of Statistics of China

- Stable and continuous increase in farmers' income

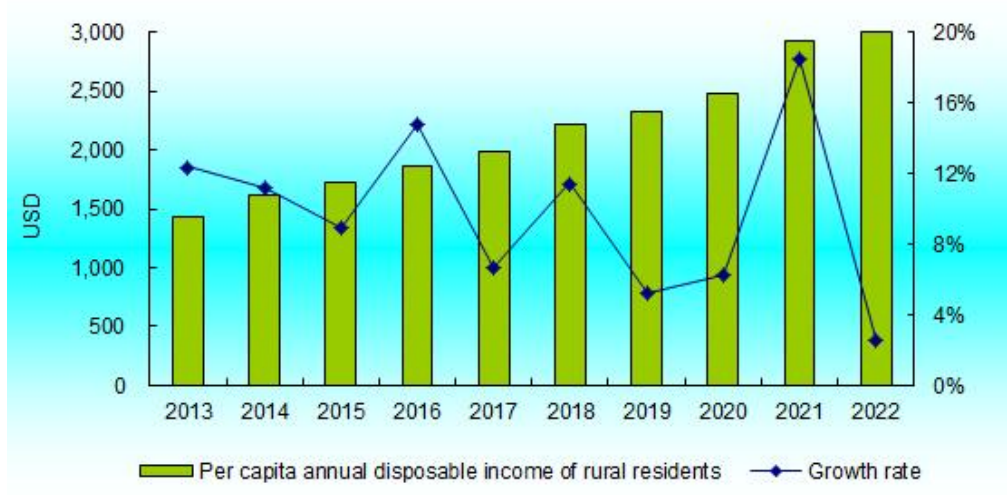
Chinese farmers are the end users of pesticides and their purchasing power, closely related to their income and the whole economic situation, plays an important role in the pesticide industry. In recent years, China has promulgated and implemented a series of policies and measures to increase farmers' income. These encouraging policies show that the Chinese government has attached more and more importance to agricultural development.

Table 1.1-1 China's policies to boost farmers' income in recent years

Item	Content
Agricultural subsidy	Provide subsidies for grain production, high-class seeds, agricultural mechanisation and agricultural means of production
Investment/Financial support	Enhance financial support for agriculture by issuing preferential policies; increase investment in agricultural infrastructure construction, animal epidemic disease prevention and control system
Price of food crops	Raise price floor of food crops in China for many years
Price of raw materials for agricultural production	Curb and control the soaring price of agricultural means of production
Cultivated land	Protect cultivated land, especially the farmland
Market	Strengthen the adjustment and management of agricultural products market

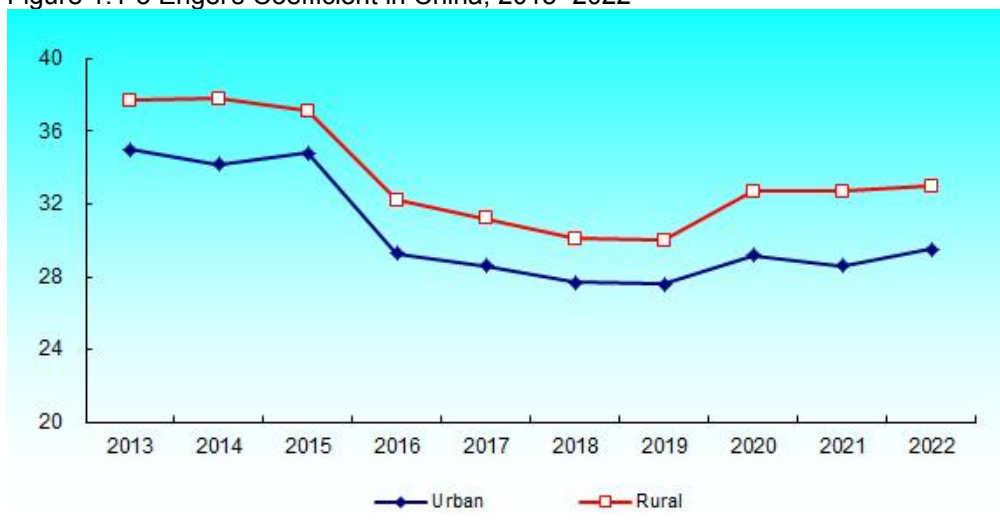
Source: CCM

Figure 1.1-2 Per capita annual disposable income of rural residents in China, 2013–2022



Source: National Bureau of Statistics of China

Figure 1.1-3 Engel's Coefficient in China, 2013–2022



Source: National Bureau of Statistics of China

With increasing profit in crop planting thanks to the government's efforts, farmers will be more willing to plant crops and invest more in pesticides. Meanwhile, the encouragement of no-tillage technology will boost the demand for pesticides. However, the increase in farmers' income is not always good for the glyphosate industry as stronger purchasing power means more choices, so some farmers might turn to other herbicides with better performance in some aspects than glyphosate. Notably, glyphosate has a disadvantage that it may lead to the death of crops while some other herbicides like diquat have no such problem.

- Low labor cost

As the "world factory", China has the advantage of relatively low labour costs. The average salary of Chinese employees keeps increasing stably every year and it has huge room to grow given its current low level. It is estimated that the average salary will rise in the coming few years, accordingly pushing up the production cost of glyphosate.

The Chinese government has issued a series of laws to ensure workers' interest in recent years. For example, the *Labor Contract Law of the People's Republic of China* has a great impact on the labor cost in China. Some details are as follows:

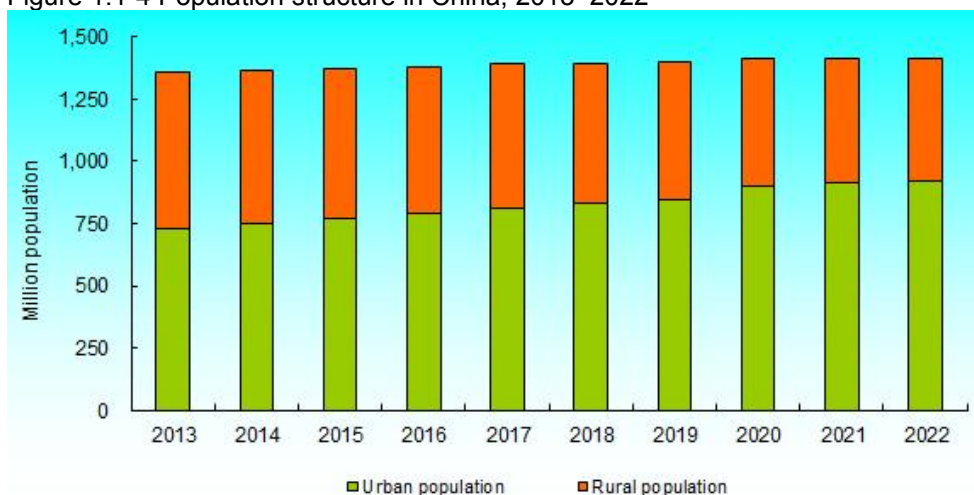
- Labor contracts shall be concluded if labor relationships are to be established.
- An employer shall pay the workers overtime wages at a rate higher (150%–300%) than that for normal working hours.
- If an employer has extended the hours of work in violation of the provisions of the law, the labour administrative department in charge shall issue a warning and command a correction and impose a fine concurrently.
- Workers enjoy the right to social insurance protection and welfare. Employers and workers shall participate in social insurance schemes according to law and pay social insurance fees.
- If an employer refuses without reason to pay social insurance fees, the labour administrative department in charge shall command a payment within a certain limit of time. If the employer fails to pay within the prescribed time limit, a fine for delaying payment shall be affixed.
- The wage paid to a worker by an employer shall not be lower than the minimum wage standard of the locality.

The minimum wage has been increasing for years, and rural migrant workers' average monthly salary has increased from USD389 (RMB2,609) in 2013 to about USD689 (RMB4,615) in 2022.

- Decreasing number of farmers

The number of Chinese farmers has been shrinking, since more and more young people from rural areas choose to work in cities in the process of China's urbanisation. The growing per capita crop planting area suggests that more and more machines and pesticides will be used, and glyphosate consumption is expected to rise accordingly.

Figure 1.1-4 Population structure in China, 2013–2022



Source: National Bureau of Statistics of China

1.2 Government policy

Different from most countries in the world, the impact of policy on most industries in China has been significant and sometimes critical to the development of the industry. The glyphosate industry is no exception. In China, few policies directly target glyphosate, but the industry is influenced by policies targeting glyphosate-related industries.

- Environmental policies

China's new environmental policies promote the adjustment of some industries including the glyphosate industry.

Environmental and energy costs in China have been much lower than those in some developed countries for a long time. That is why the global production of some industries with serious pollution has been shifted to China in recent years. Now the Chinese government is strengthening its management of environmental protection through measures to restrict blind capacity enlargement and impel manufacturers to improve their production technology.

Since May 2013, the Ministry of Environmental Protection of the People's Republic of China has launched the environmental protection verification (EPV) for glyphosate (PMIDA). It is required that during the pollution control procedure:

- The yield of glyphosate technical (AEA pathway) shall be no less than 70%;
- The yield of glyphosate technical (IDA pathway) shall be no less than 75%;
- The comprehensive utilization rate of the phosphorus element shall be no less than 80%;
- The recycling rate of sodium chloride shall be no less than 85%.

In April 2019, the Ministry of Ecology and Environment of the People's Republic of China issued the *Implementation Plan for Investigation and Rectification Activities Targeting on "Three Phosphorous" Industries in Provinces along the Yangtze River*, which deals with the "Three Phosphorous" (phosphorite mining, phosphorus chemical and phosphogypsum stack) industries and clearly defined the overall requirements and work arrangements for the special programme:

- Phosphorite mining industry: treatments aim to achieve up-to-standard expelled mine water, effective control of dust in the mining area and ecological restoration after mining.
- Phosphorus chemical industry: focuses are separation of rainwater and sewage, effective collection and treatment of initial rainwater, setting-up and normal operation of pollution prevention and control facilities, and up-to-standard wastewater discharged. Specifically, phosphate fertiliser producers are to ensure that sewage treatment facilities are equipped and wastewater is effectively reused; phosphorous pesticide enterprises are to strengthen the recovery and treatment of mother liquor; yellow phosphorus manufacturers are to make sure zero discharge of phosphorous-contained wastewater and prevent yellow phosphorus loss during the process.
- Phosphogypsum stack: regular monitoring of groundwater, effective collection and treatment of leachate, standardised construction of return pool, flood detention ditch and floodway, and comprehensive utilization of phosphogypsum should be pursued.

The work can be divided into five stages:

1. Problem checking: make a list of problems and sort out typical ones in the industries.
2. Rectification plan deciding: work out a plan for each enterprise. Classify the problems identified and record rectification measures.
3. Double check for loopholes and hidden hazards: strengthen supervision, check the problem list and corresponding rectification measures, watch out for loopholes and dig up hidden hazards. The rectification of yellow phosphorus manufacturers should be finished at this stage.
4. Follow-up supervision: track the rectification progress and the overall schedule. Complete the rectification of phosphorite mining, phosphate fertiliser and phosphorus pesticide enterprises.
5. Result assessment: promote the rectification of key phosphogypsum stacks, solve outstanding problems and assess the effectiveness of this special programme.

- Policies on export

China's export tax rebates on glyphosate and PMIDA have been cancelled since 15 July, 2010 and 1 Jan., 2013 respectively.

- Support for key enterprises

On 29 Jan., 2022, the Ministry of Agriculture and Rural Affairs (MARA) issued the *Development Plan of the National Pesticide Industry for the 14th Five-year (2021–2025)*, encouraging domestic pesticide enterprises to expand their scale through M&A, restructure, transformation and upgrading approaches, and promoting the cultivation of large- and medium-sized producers with strong competitiveness. It is stipulated in the Plan that:

- More than 10 enterprises will achieve an annual output value over USD746.58 million (RMB5 billion), more than 50 enterprises over USD149.32 million (RMB1 billion) and more than 100 enterprises over USD74.66 million (RMB500 million) by 2025;
- The number of pesticide producers will be reduced from 1,705 to below 1,600 by 2025.

- Unfavourable policies on glyphosate enterprises

Newly constructed glyphosate technical installations have been listed as a restricted project in the *Catalogue for Guiding Industry Restructuring (2011 Version)*, which means that no new glyphosate technology projects have been permitted in China since May 2013.

Among all the policies, the impact of environmental policies is the most direct and significant for the Chinese glyphosate industry at the time being, because the increasingly stricter environmental policies have led to a significant increase in the production cost of the product during the past few years.

1.3 Global demand

The global demand for glyphosate has kept increasing stably from 680,000 tonnes in 2012 to 734,000 tonnes in 2014, mainly because of its wider application in planting of soybean, cotton, and corn which have been genetically modified to tolerate glyphosate.

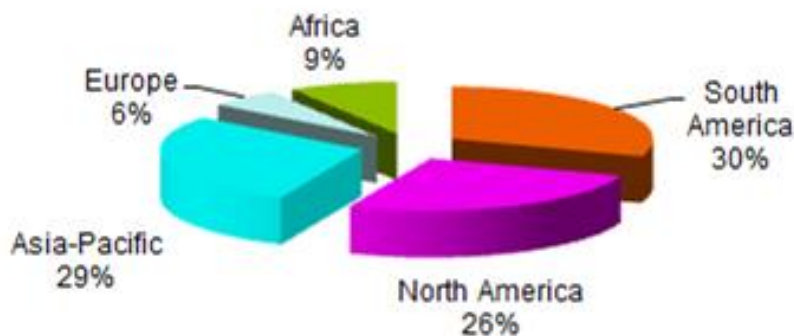
Nevertheless, the global demand for glyphosate decreased in 2015 with the declining planting area of GM crops in the world, in that their low prices led some farmers to shift away from growing corn, cotton and rapeseed to more manageable crops such as GM soybeans and also other less demanding crops like beans, sunflowers and sorghum.

Since 2016, due to the increase in the global planting area of GM crops, the global demand for glyphosate has continued to increase. The global demand in 2019–2022 was stable at over 700,000 tonnes.

Most industry participants believe that the global planting of GM crops remains the main driver of future glyphosate demand growth. Other important influencing factors include the development of biofuels, promotion of no-tillage technology, emergence or evolution of glyphosate-tolerant weeds, weather and competition from rival products. There are currently no alternatives to glyphosate, so glyphosate will continue to be a key herbicide in China with steady demand growth over the next decade.

Glyphosate is mainly consumed in American countries, especially the US, Brazil and Argentina, which are the top three biotech crop planting countries worldwide. In 2022, they planted GM crops of 75 million hectares, 57 million hectares and 26 million hectares in area respectively. And these three countries each consume over 380 million litres, 340 million litres and 300 million litres of glyphosate-based herbicides annually and together account for about 50% of the global total.

Figure 1.3-1 Global consumption of glyphosate by region, 2022



Source:CCM

1.4 Entry barriers of glyphosate industry

It is not easy for newcomers to enter China's glyphosate industry due to the following barriers.

- Policy

The Chinese government has strict requirements on registration, production licence, environment evaluation, etc. Generally, it takes about two years to obtain a pesticide production licence. Moreover, the pesticide production licence that Chinese producers obtained has a short validity period of five years, and they have to renew the licence to maintain their production.

According to the *Measures for the Administration of Pesticide Business Licensing* issued by MARA in 2017, a pesticide operator shall be equipped with personnel qualifications, business premises and storage sites, information recording systems, safety and security measures, etc. The requirements are detailed as follows:

- It shall have the operating personnel who have the educational background of a technical secondary school or above in agronomy, plant protection, pesticide or any other specialities or the learning experience of more than 56 credit hours in professional education and training institutions, know well the pesticide administration provisions, master the professional knowledge in pesticides and pest control, and are able to guide the safe and rational use of pesticides.
- It shall have business premises of not less than 30 square meters and a storage place of not less than 50 square meters, and such places are effectively separated from other commodities, living areas and sources of drinking water; and if it concurrently operates other agricultural inputs, it shall have a relatively independent pesticide operation area.
- Its business premises and place of storage shall be equipped with ventilation, fire prevention, poisoning prevention and other facilities, and have the storage racks, counters and other display and exhibition facilities and equipment appropriate for the categories and types of the operated pesticides.
- It shall have traceable electronic information code scanning equipment and the computer management system used for recording the electronic ledgers on pesticide purchase, storage and sales, among others.
- It shall have a management system for purchase checks, ledgers recording, safety management, safety protection, emergency disposal, storage management, pesticide waste recycling and disposal, and use guidance, among others, and the position-related operational rules.
- Other conditions as prescribed by the Ministry of Agriculture.

In addition, newly constructed glyphosate technical installations have been listed as a restricted project in the *Catalogue for Guiding Industry Restructuring* (2019 Version), which means the new glyphosate technical projects would no longer be permitted in China.

- Capital

To enter glyphosate industry, considerable capital investment is required.

In 2008, the National Development and Reform Commission released the *Notice on Further Strengthening the Management of Pesticide Industry*, proposing to further raise the threshold for newly approved pesticide enterprises.

Table 1.4-1 Capital thresholds for glyphosate manufacturers in China

Item	Technical producer	Formulation producer
Investment	≥RMB50 million (Land use fee excluded)	≥RMB20 million (Land use fee excluded)
Environmental protection investment	≥15% of total investment	≥8% of total investment
Registered capital	At least RMB50 million	At least RMB30 million
Others	Machine, technician, management and so on	
Cost	≥RMB100 million for 10,000 t/a glyphosate technical project (including supporting facilities, waste treatment equipment, by-product installations, etc.)	/

Source: National Development and Reform Commission

- Technology

All the three production routes adopted in China are mature, but the technologies of waste treatment and by-product recovery are challenges for many companies. Actually, some producers have invested in improving their waste treatment technology or waste treatment equipment. Yet it is difficult for a player without much experience in R&D. Meanwhile, differences in key process indicators among different processes, or even the same process, have great influences on product quality and yield. Without long-term experience, it is difficult to master advanced technology in a short period of time, which means that production costs for new entrants are higher and yields less satisfactory.

On the other hand, how to protect the patent and retain technicians is a great challenge for China's glyphosate manufacturers, especially for new entrants, because there is a risk that glyphosate technology could be leaked by some job-hopping technicians. For example, with job-hopping of many technicians in Zhejiang Wynca Chemical Industrial Group Co., Ltd. (Zhejiang Wynca), many manufacturers came to have a knowledge of and adopted the technology of recovering chloromethane in glyphosate production developed by Zhejiang Wynca. Zhejiang Wynca only sued one of them—Zhejiang Jinfanda Bio-chemical Co., Ltd. (Zhejiang Jinfanda) who finally had to pay RMB20 million to Zhejiang Wynca. But there are still many manufacturers using the technology.

2 Glyphosate upstream industries

2.1 Key raw materials & intermediates of glyphosate

The two production routes for glyphosate technical require different raw materials.

- AEA pathway

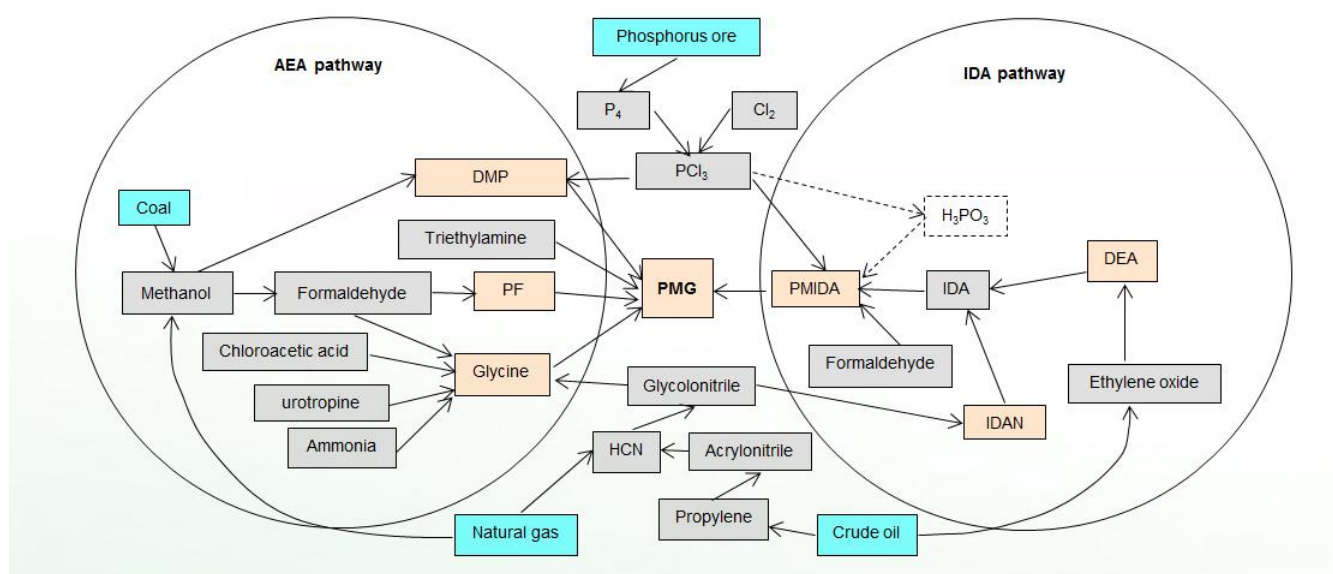
The key raw materials include glycine, dimethyl phosphite (DMP) and paraformaldehyde (PF). Since DMP is mainly produced by glyphosate producers themselves, DMP is not introduced in detail here.

- IDA pathway

For the DEA route, the most important material is diethanolamine (DEA). As for the iminodiacetonitrile (IDAN) route, the most important material is IDAN produced by the natural gas route.

In the IDA pathway, n-(phosphomethyl) iminodiacetic acid (PMIDA) is the most important intermediate. Some companies produce and sell it; some companies purchase PMIDA to produce glyphosate technical.

Figure 2.1-1 Different pathways for producing glyphosate technical and value chain of key raw materials



Source:CCM

2.2 Glycine

In China, glycine is mainly consumed in the domestic glyphosate industry. According to the production process and product purity, glycine can be divided into four categories, namely pharmaceutical grade, food grade, feed grade and industrial grade (also called tech-grade), and only the last one is applied in glyphosate technical production for its lower price. Unit consumption of industrial-grade glycine is 0.55 t/t–0.60 t/t in glyphosate technical production now.

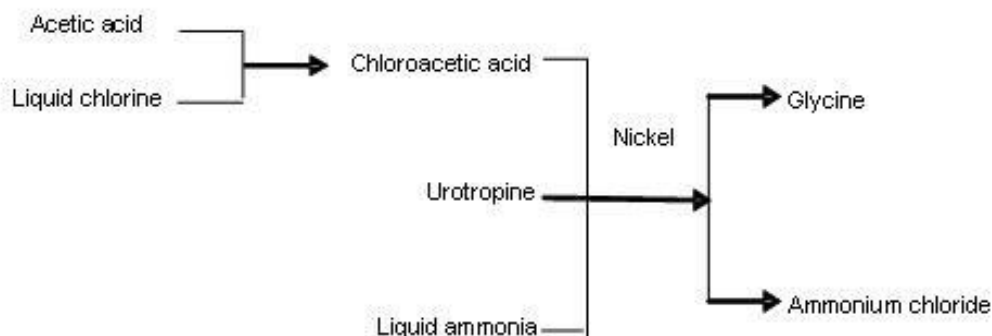
- Technology

There are three major glycine production methods in the world, namely the chloroacetic acid ammonolysis process, the Strecker process and the hydantion process.

In China, glycine is mainly produced via the chloroacetic acid ammonolysis process, which is a mature production technology adopted by almost all domestic glycine producers except Guang'an Chengxin Chemical Co., Ltd. (Guang'an Chengxin).

Guang'an Chengxin is the only company in China adopting the hydantion process to produce glycine. This production process has advantages such as less reaction steps, higher yield, higher purity, lower production cost and less pollution, compared with the chloroacetic acid ammonolysis process.

Figure 2.2-1 Flowchart of the chloroacetic acid ammonolysis process for glycine production



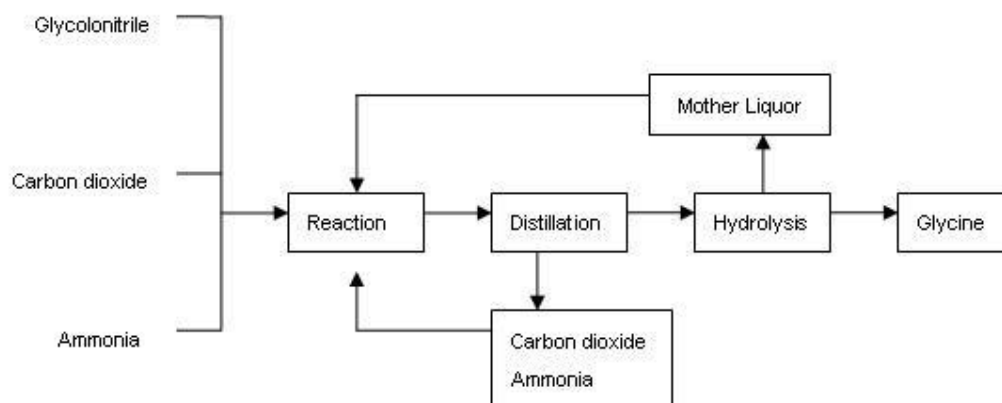
Source:CCM

Table 2.2-1 Raw material consumption and unit cost of the chloroacetic acid ammonolysis process for glycine production in China, May 2023

No.	Raw material	Purity, %	Unit consumption, t/t	Price, USD/t	Unit cost, USD/t
1	Chloroacetic acid	95	1.52	420	638
2	Liquid ammonia	99.6	0.58	579	336
3	Urotropine	98	0.16	1,130	181
4	Methanol	98	0.07	348	24
Total		/	/	/	1,179

Source:CCM

Figure 2.2-2 Flowchart of the hydantion process for glycine production



Source:CCM

- Production

Chinese glycine industry has always witnessed overcapacity in the past few years, and this situation is not expected to change much in the coming few years though some glycine producers may shift their glycine installations to produce other amino acids.

National capacity of glycine (tech-grade) reached 511,000 t/a in 2017, during which Hebei Chuncheng Biological Technology Co., Ltd finished a 10,000 t/a tech-grade glycine project and Hebei Huaheng Biological Technology Co., Ltd. completed a 22,000 t/a tech-grade glycine project.

In 2018, the capacity increased to 561,000 t/a. Specifically, Hebei Donghua Chemical Group Co., Ltd.'s capacity expanded from 182,000 t/a to 192,000 t/a; Xizang Newtrend Fine Chemical Co., Ltd.'s 40,000 t/a tech-grade glycine project was completed and put into trial operation by the end of 2017. Besides, the

30,000 t/a tech-grade glycine and 10,000 t/a food-grade glycine of Hainan Zhengye Fine Chemical Co., Ltd. was put into production in 2018.

In 2019, the capacity of tech-grade glycine maintained at 561,000 t/a, with the entry and exit of individual producers from the market.

In 2020, the national capacity of tech-grade glycine reached 581,000 t/a. Linyi Hongtai Chemical Co., Ltd.'s 20,000 t/a glycine expansion project was completed and put into operation. Shaanxi Beiyuan Chemical Industry Group Co., Ltd. proposed a 120,000 t/a glycine project, and the pilot installation with a capacity of 95 t/a was built up and put into trial in July.

In 2021, Cangzhou Huachen Biotechnology Co., Ltd. completed its 30,000 t/a new glycine project in November. And the national capacity reached 603,000 t/a in 2021.

In 2022, the capacity remain stable generally. Some new projects were detailed as follows:

- In March, Guang'an Chengxin commenced the construction of an expanded glycine production plant with a capacity of 30,000 t/a. After the production line is completed and put into operation, the company's production capacity will be increased to 50,000 t/a;
- In May, Hebei Donghua Jiheng Amino Acid Technology Co., Ltd. announced the plan to expand the existing production capacity of 20,000 t/a glycine to 40,000 t/a. It is a subsidiary of Hebei Donghua Chemical Group Co., Ltd., the production capacity of which will increase to 212,000 t/a once the expansion is completed;
- At the end of October, the 120,000 t/a glycine project of Shaanxi Beiyuan Chemical Industry Group Co., Ltd. started construction in Yulin City, Shaanxi Province;
- In November, Fuhua Tongda Chemical Co., Ltd. announced that it planned to make technical changes to the "glycine drying process" and "ammonium chloride enrichment process" in the existing 40,000 t/a glycine project without changing the capacity;
- In early December, the civil engineering of Inner Mongolia Zhongyuan Pharmaceutical Co., Ltd.'s 10,000 t/a glycine project has been basically completed, and the equipment installation entered the final stage;

In Jan. 2023, Kaifeng Longxing Chemical Co., Ltd. announced that its 20,000 t/a glycine project (Phase I) will be commissioned from Jan.–June, 2023. Once the project is put into operation, China's glycine capacity will further increase.

Table 2.2-2 Capacity and output of glycine in China, 2018–2022

Year	Capacity, t/a		Output, tonne	
	Industrial grade	Other grade	Industrial grade	Other grade
2018	561,000	129,800	325,000	56,600
2019	561,000	138,800	338,000	56,400
2020	581,000	138,800	340,000	60,200
2021	603,000	138,800	352,500	61,500
2022	603,000	138,800	364,500	62,300

Source:CCM

Table 2.2-3 Producers of tech-grade glycine in China, 2018–2022

No.	Producer	Abbr.	Capacity in 2022, t/a	Output, tonne				
				2018	2019	2020	2021	2022
1	Hebei Donghua Chemical Group Co., Ltd.	Hebei Donghua	192,000	140,000	130,000	130,000	130,000	128,000
2	Hubei Trisun Chemicals Co., Ltd.	Hubei Trisun	100,000	73,000	84,000	80,000	88,000	86,000
3	Linyi Hongtai Chemical Co., Ltd.	Linyi Hongtai	70,000	30,000	28,000	35,000	35,000	34,000
4	Fuhua Tongda Chemical Co., Ltd.	Fuhua Tongda	40,000	22,000	25,000	25,000	26,000	25,000
5	Xizang Newtrend Fine Chemical Co., Ltd.	Xizang Newtrend	40,000	6,000	6,000	6,000	6,000	10,000
6	Hainan Zhengye Fine Chemical Co., Ltd.	Hainan Zhengye	30,000	2,000	8,000	10,000	10,000	10,000
7	Cangzhou Huachen Biotechnology Co., Ltd.	Cangzhou Huachen	30,000	/	/	/	3,000	15,000
8	Hebei Huaheng Biological Technology Co., Ltd.	Hebei Huaheng	22,000	4,000	5,000	5,000	5,000	5,000
9	Guang'an Chengxin Chemical Co., Ltd.	Guang'an Chengxin	20,000	15,000	17,000	17,000	17,000	17,000
10	Henan HDF Chemical Co., Ltd.	Henan HDF	15,000	12,000	11,000	10,000	11,000	10,000
11	Inner Mongolia Xingfa Technology Co., Ltd.	Inner Mongolia Xingfa	10,000	10,000	10,000	10,000	10,000	10,000
12	Hebei Chuncheng Biological Technology Co., Ltd.	Hebei Chuncheng	10,000	5,000	5,000	5,000	3,500	3,500
Others			24,000	6,000	9,000	7,000	8,000	11,000
Total			603,000	325,000	338,000	340,000	352,500	364,500

Source:CCM

- Price

Only the price of tech-grade glycine in China is analysed here, as the products of the other three grades are made from the tech-grade and their prices are mainly subject to the tech-grade's.

Glycine price in China is influenced by the price of glyphosate technical, instant supply of & demand for glycine, government policies, and the price of glycine's raw materials including chloroacetic acid, urotropine, liquid ammonia and methanol.

- Glyphosate technical price

Glycine price in China is largely related to the price of glyphosate technical, since about 75% of tech-grade glycine is applied in the domestic glyphosate industry.

- Instant supply of & demand for glycine

There is a great oversupply in glycine in China, and in most cases, glycine price won't change much. However, the price may increase a lot when the instant supply cannot meet the demand.

- Government policies

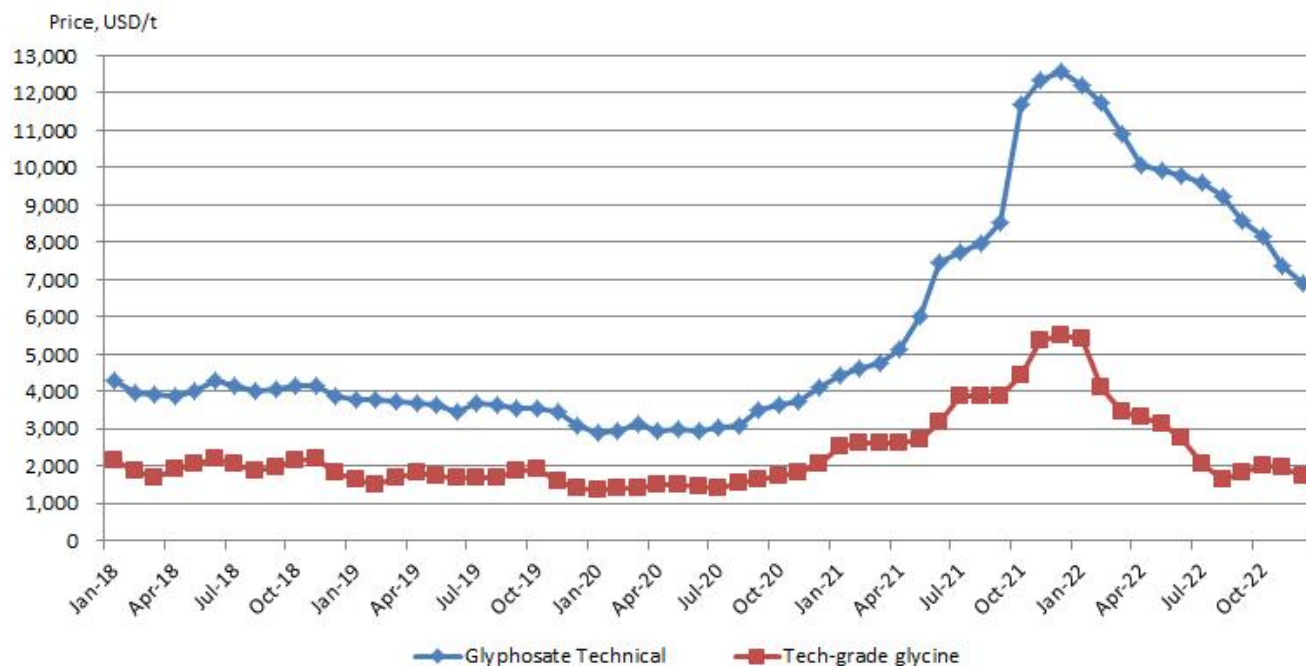
Under the guidance of national industrial policies, China's amino acid industry develops rapidly. And due to some environmental policies, supply of and demand for glycine and enterprises' operating profits in China

are limited, affecting the price of glycine. For example, on 17 Nov., 2016, Hebei Province, the main glycine production base, issued the 2nd air pollution control scheduling order, and glycine production was under stricter supervision, leading to a tight supply of glycine.

- Raw material price

The cost of raw materials, like urotropine and chloroacetic acid, accounts for over 80% of the total production cost of glycine.

Figure 2.2-3 Monthly average ex-works price of tech-grade glycine and glyphosate technical in China, Jan. 2018–Dec. 2022



Note: The glycine prices presented are for tech-grade glycine.
Source: CCM

- Consumption

Major end-use segments of glycine are glyphosate, food, feed and pharmaceutical in China. In 2022, 75% of tech-grade glycine was applied in the domestic glyphosate industry, and the rest was consumed to produce food-, feed- and pharmaceutical-grade glycine.

The domestic consumption of tech-grade glycine kept increasing from 2011 to 2016. The figure dropped temporarily in 2017, but in the following years, it stabilised at around 260,000 tonnes. All these ups and downs are driven by changes in the output of glycine route glyphosate.

Table 2.2-4 Consumption of glycine in glyphosate production in China, 2018–2022

Item	2018	2019	2020	2021	2,022
Output of glyphosate tech. (AEA pathway), tonne	444,000	442,000	452,000	449,000	450,000
Consumption of glycine, tonne	258,000	257,000	263,000	261,000	262,000

Source: CCM

Currently, three production routes are adopted in the glyphosate industry in China, namely the glycine route, IDAN route and DEA route. Output of glyphosate technical produced through the glycine route, the dominant one, accounted for 72%–76% of the total glyphosate output in China in 2018–2022.

Table 2.2-5 Main glycine producers and glycine consumers in glyphosate industry in China, 2022

No.	Glycine producer	Glycine consumer
1	Hebei Donghua	Fuhua Tongda, Zhejiang Wynca, Nantong Jiangshan Agrochemical & Chemicals Co., Ltd., Anhui Dongzhi Guangxin Agrochemical Co., Ltd., etc.
2	Hubei Trisun	Hubei Trisun, Inner Mongolia Xingfa, Jiangxi Jinlong Chemical Co., Ltd., etc.
3	Fuhua Tongda	Fuhua Tongda
4	Linyi Hongtai	Zhejiang Wynca, Nantong Jiangshan Agrochemical & Chemicals Co., Ltd., etc.
5	Henan HDF	Henan HDF
6	Inner Mongolia Xingfa	Inner Mongolia Xingfa

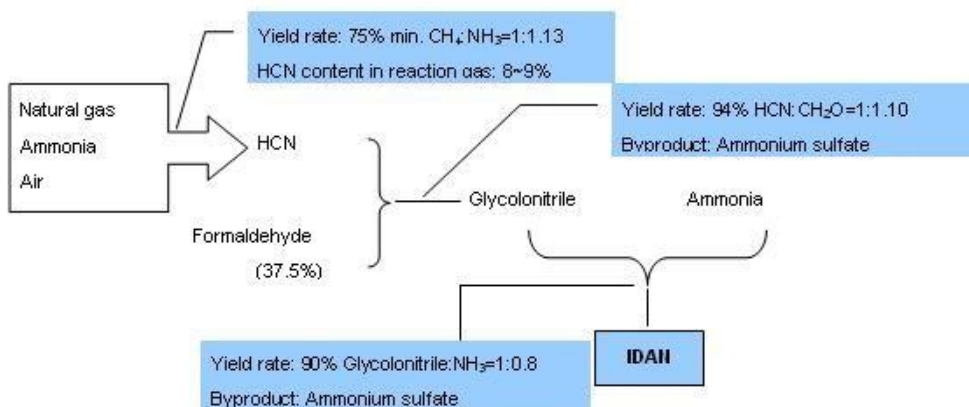
Source:CCM

2.3 IDAN

- Routes to produce IDAN

Natural gas is taken as the starting material to produce HCN & IDAN in China.

Figure 2.3-1 Production process of IDAN by natural gas route in China



Source:CCM

- Production

Figure 2.3-2 Capacity and output of IDAN in China, 2013–2022



Source:CCM

During 2013–2016, the capacity of IDAN kept over 200,000 t/a, but due to oversupply, it began to decline in 2017. By 2022, the capacity reduced to 175,000 t/a, with only 3 producers operating in China.

As for output, IDAN's output in China peaked at 148,000 tonnes in 2014, but in the following years, IDAN's output decreased and kept stable at around 110,000–120,000 tonnes (except for 2019).

- Key IDAN producers

Table 2.3-1 Capacity and output of IDAN producers in China, 2018–2022

No.	Producer	Status in 2022	Capacity in 2022, t/a	Output, tonne				
				2018	2019	2020	2021	2022
1	Leshan Hebang Agricultural Technology Co., Ltd.	Active	100,000	70,000	70,000	99,000	100,000	100,000
2	Chongqing Unisplendour Chemical Co., Ltd.	Active	50,000	32,000	10,000	7,500	6,500	6,000
3	Guang'an Chengxin Chemical Co., Ltd.	Active	25,000	12,000	12,000	12,000	14,000	14,000
Total			175,000	114,000	92,000	118,500	120,500	120,000

Source:CCM

Chongqing Unisplendour Chemical Co., Ltd., a major IDAN supplier in China, has two IDAN production bases located in Inner Mongolia and Xinjiang regions with IDAN capacity of 30,000 t/a and 20,000 t/a respectively.

Leshan Hebang Agricultural Technology Co., Ltd. (Leshan Hebang), which established a complete integrated chain of glyphosate (IDAN route) from natural gas to HCN (45,000 t/a), glycolonitrile (90,000 t/a), IDAN (100,000 t/a), PMIDA (180,000 t/a) and glyphosate technical (50,000 t/a), has successfully changed the domestic market structure of glyphosate industry. Almost all domestic glyphosate producers purchased IDAN to produce PMIDA and then glyphosate technical, but since 2015, some of them switched to purchasing PMIDA produced by Leshan Hebang to produce glyphosate technical.

- Price of IDAN

The price of IDAN in China is mainly affected by the price of glyphosate technical and raw material costs, under the oversupply of IDAN.

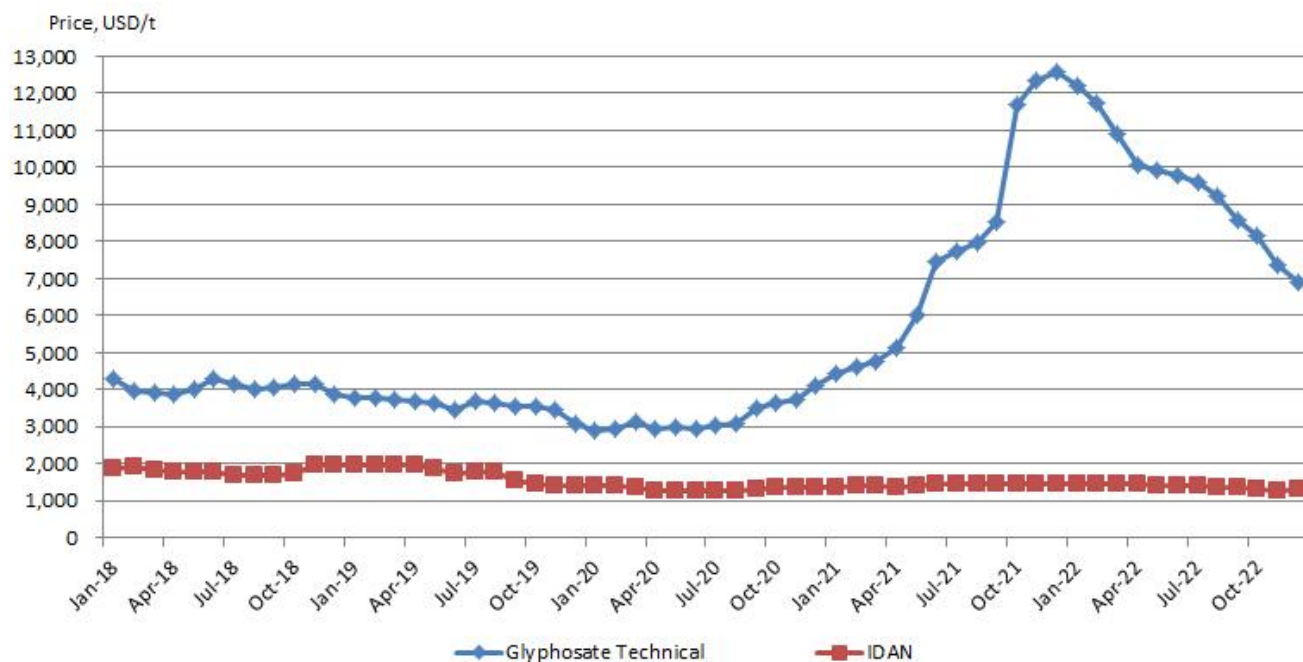
- Price of glyphosate technical

The domestic price of IDAN was influenced by that of glyphosate technical, especially when the price of glyphosate technical is high because PMIDA & glyphosate technical is the only end-use segment of IDAN in China.

- Raw material cost

The raw material cost usually takes up about 70% of the total production cost of IDAN. And natural gas plays the most important role in raw material cost, as it is not only the starting raw material of IDAN but also the raw material of the other important raw materials of IDAN, such as formaldehyde and liquid ammonia. Thus, the price change of natural gas has a large impact on the production cost of IDAN.

Figure 2.3-3 Monthly average ex-works price of IDAN and 95% glyphosate technical in China, Jan. 2018–Dec. 2022



Source:CCM

- Consumption of IDAN

IDAN can be applied to PMIDA & glyphosate technical production, electroplate, water treatment, etc., but in China, it is used to produce PMIDA & glyphosate technical only.

Table 2.3-2 Key glyphosate technical producers adopting IDA pathway in China, 2022

No.	Company	Capacity, t/a	
		Glyphosate technical (IDA pathway)	Glyphosate technical
1	Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	62,000	62,000
2	Leshan Hebang Agricultural Technology Co., Ltd.	50,000	50,000
3	Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.	40,000	70,000
4	Jiangsu Yangnong Chemical Co., Ltd.	35,000	35,000
5	ADAMA Ltd.	20,000	20,000
6	Guang'an Chengxin Chemical Co., Ltd.	20,000	20,000
7	Jingma Chemicals Co., Ltd.	15,000	15,000
Total		242,000	272,000

Note: Jiangsu Yangnong mainly consumes DEA to produce glyphosate technical, and it also purchases PMIDA produced by Leshan Hebang to produce glyphosate technical.

Source:CCM

2.4 DEA

Diethanolamine (DEA) is produced together with monoethanolamine (MEA) and triethanolamine (TEA). The output ratio of MEA, DEA and TEA varies from company to company, according to the addition of ethylene oxide (EO). For example, Zhejiang Jiaxing Jinyan Chemical Co., Ltd.'s output ratio is 7:8:5, while Lotte Chemical (Jiaxing) Corp.'s output ratio is 2:6:2.

- Production

China's DEA capacity was maintained at 166,000 t/a in 2018–2020. But it increased to 196,000 t/a in 2021, up by 18.07% year on year. In 2020, domestic DEA's output declined to a record low because of the outbreak of the COVID-19 pandemic and the surging volume of imported DEA. In 2021, China's DEA's output recovered due to the decreasing imported DEA.

Figure 2.4-1 Capacity and output of DEA in China, 2018–2022



Source:CCM

There were seven active DEA producers in China as of 2022.

Table 2.4-1 Capacity and output of DEA producers in China, 2018–2022

No.	Company	Status in 2022	Capacity in 2022, t/a	Output, tonne				
				2018	2019	2020	2021	2022
1	Jiangsu Sailboat Petrochemical Co., Ltd.	Active	49,000	18,000	20,000	16,000	19,000	19,000
2	Zhongke (Guangdong) Refinery & Petrochemical Co., Ltd.	Active	30,000	/	/	/	19,000	18,000
3	Lotte Chemical (Jiaxing) Corp.	Active	30,000	12,000	12,800	8,000	11,000	11,000
4	BASF-YPC Company Limited	Active	25,000	23,000	25,000	25,000	25,000	25,000
5	Hubei Xianlin Chemical Co., Ltd.	Active	20,000	3,500	6,500	5,000	7,000	7,000
6	Zhejiang Jiaxing Jinyan Chemical Co., Ltd.	Active	20,000	5,500	5,800	6,000	4,200	4,200
7	Maoming Petro-chemical Shihua Co., Ltd.	Active	6,000	3,800	4,500	5,500	5,000	4,000
8	Oriental Petrochemical (Yangzhou) Corporation	Idle	16,000	6,000	6,300	5,500	0	0
Total			196,000	71,800	80,900	71,000	90,200	88,200

Source:CCM

At the end of 2020, the 50,000 t/a EA project of Zhongke (Guangdong) Refinery & Petrochemical Co., Ltd. was put into operation, producing MEA, DEA and TEA.

On 9 June, 2022, Maoming Shihua Dongcheng Chemical Co., Ltd. (Shihua Dongcheng), a controlling subsidiary of Maoming Petro-Chemical Shihua Co., Ltd., temporarily ceased production of the 20,000 t/a ethanolamine facility located in Maoming High-tech Industrial Development Zone due to a sudden fire from upstream raw material suppliers, which prevented the supply of production materials to the facility. On 12 August, 2022, upstream raw material suppliers resumed production and supply of raw materials to the ethanolamine facility of Shihua Dongcheng. While ensuring safety, the ethanolamine unit has resumed production.

- Import & export of DEA in China

China's Ministry of Commerce proclaimed on 30 October, 2017 that it would launch an anti-dumping investigation on EA (including MEA, DEA and TEA) originally produced in the US, Saudi Arabia, Malaysia and Thailand.

Finally, the Ministry of Commerce has decided that from 30 October, 2018, import operators shall pay the relevant margin to the General Administration of Customs. The anti-dumping duties on the above-mentioned products are 10.1%–97.1% with a period of 5 years.

Table 2.4-2 China's margin rates on EA for different companies, since 23 June, 2018

Origin		Margin rate
US companies	The Dow Chemical Company	76.0%
	INEOS Americas LLC	97.1%
	Huntsman Petrochemical LLC	97.1%
	Others	97.1%
Saudi Arabian companies	Saudi Basic Industries Corporation	10.1%
	Others	27.9%
Malaysian companies	Petronas Chemicals Derivatives Sdn Bhd	18.3%
	Others	20.3%
Thai companies	Toc Glycol Company Limited	37.6%
	Others	37.6%

Source:CCM

Despite the levy of anti-dumping duties, the Chinese glyphosate industry is almost not affected by this measure, because Chinese PMIDA & glyphosate producers mainly consume imported DEA with the shipment mode of Processing with Imported Materials and no anti-dumping duty is imposed.

China is a net importer of DEA because of the low price of overseas DEA. China's import volume of DEA increased rapidly from 34,192 tonnes in 2013 to 124,023 tonnes in 2020. In 2021–2022, the import volume decreased compared with 2020, due to the increased domestic output.

The average import price kept decreasing (from more than USD1,400/t in 2013–2014 to below USD1,000/t in 2019–2022), because of the declining production cost and weakening anti-dumping measures in recent years.

Figure 2.4-2 China's imports of DEA, 2013–2022



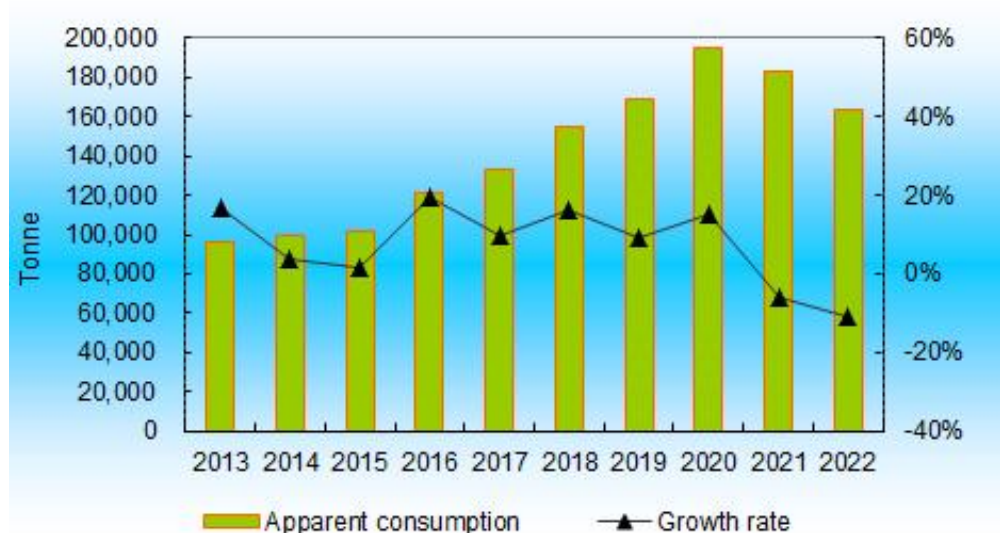
Source:CCM

- Consumption of DEA

DEA can be widely used to produce DEA salts of long-chain fatty acids that are formulated into soaps and surfactants used in liquid laundry and dishwashing detergents, cosmetics, shampoos and hair conditioners. Also, it is used in textile processing, industrial gas purification to remove acid gases, as an anticorrosion agent in metalworking fluids, and in preparations of agricultural chemicals. Besides, aqueous DEA solutions are used as solvents for numerous drugs that are administered intravenously.

In China, DEA is mainly consumed in PMIDA & glyphosate technical and surfactants. Producing one tonne of glyphosate technical needs 0.78–0.92 tonne of DEA.

Figure 2.4-3 Apparent consumption of DEA in China, 2013–2022



Source:CCM

PMIDA & glyphosate technical is one of the key end-use segments of DEA in China, with an annual consumption of DEA of 57,000 tonnes–80,000 tonnes in 2007–2010.

DEA consumption in PMIDA & glyphosate technical decreased rapidly to about 42,000 tonnes in 2014, about 25,000 tonnes in 2015 and about 23,000 tonnes in 2016–2017, because of the increasing competition from its competitive products—glycine and IDAN, key raw materials for the other two production routes of glyphosate technical.

And annual DEA consumption in glyphosate production remained stable at 27,000 tonnes in 2018–2022.

DEA is one of the major raw materials for glyphosate production by the IDA pathway. Currently, among the five glyphosate producers adopting the IDA pathway in China, four take IDAN or PMIDA (produced from IDAN) as raw materials, and only one takes DEA as raw material.

The output of glyphosate technical taking DEA as raw material in China was 26,000 tonnes in 2015–2017, and 30,000 tonnes in 2018–2022.

2.5 Paraformaldehyde

- Production

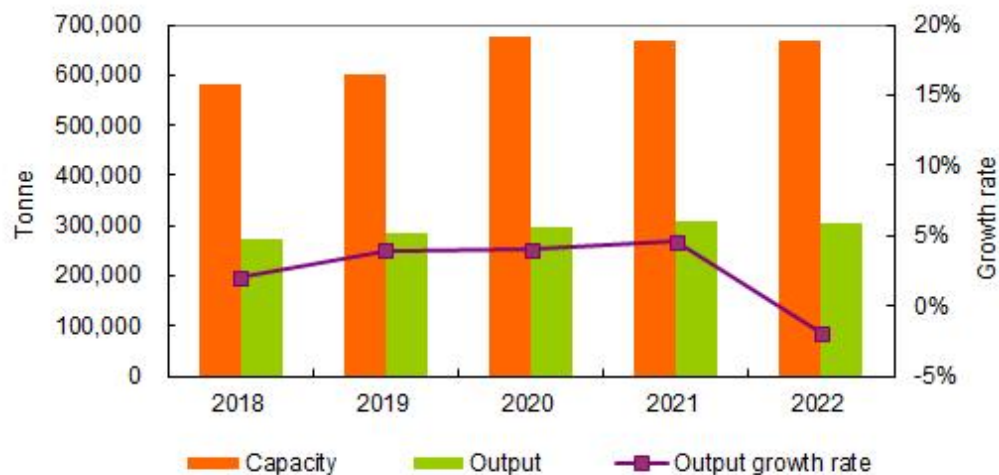
China's PF capacity increased from 581,000 t/a in 2018 to 667,000 t/a in 2022. Some companies in East China stopped PF production because of stricter environmental protection policies or poor performance, while many new projects were built in Northwest China. As for the output, it kept growing, from 273,000 tonnes in 2018 to 302,700 tonnes in 2022, along with stable increasing domestic demand.

Table 2.5-1 Capacity and output of key PF producers in China, 2018–2022

No.	Producer	Capacity in 2022, t/a	Output, tonne				
			2018	2019	2020	2021	2022
1	Nantong Jiangtian Chemical Co., Ltd.	80,000	41,000	41,000	40,000	59,000	62,000
2	Fuhua Tongda Agro-chemical Technology Co., Ltd.	60,000	58,000	58,000	58,000	58,000	57,000
3	Shandong Zhengxin New Energy Co., Ltd.	40,000	/	/	5,000	5,000	6,000
4	Xinjiang Dearsun Chemical Co., Ltd.	40,000	10,000	15,000	16,000	14,000	10,000
5	Hebei Jintaida Chemical Co., Ltd.	40,000	30,000	30,000	28,000	26,000	25,000
6	Hubei Trisun Chemicals Co., Ltd.	33,000	20,000	23,000	33,000	32,400	32,000
7	Ningxia Huaye Fine Chemical Co., Ltd.	30,000	/	/	/	3,000	4,000
8	Ningxia Jinhai Xinning Chemical Co., Ltd.	30,000	5,000	8,000	8,000	8,000	7,000
9	Hengshui Yinhe Chemical Co., Ltd.	30,000	10,000	8,500	8,000	8,000	8,000
10	Hebei Yuhang Chemical Co., Ltd.	30,000	20,000	20,000	20,000	18,200	17,800
11	Zhenjiang LCY Performance Materials Co., Ltd.	30,000	33,000	33,500	33,000	33,600	24,800
12	Zibo Qixing Chemical Technology Co., Ltd.	20,000	4,000	5,000	4,500	5,000	5,000
13	Jiangsu Sanmu Group Co., Ltd.	20,000	5,000	5,000	5,000	5,400	6,000
14	Xinjiang Wanchang New Energy Co., Ltd.	20,000	5,000	8,000	6,000	6,000	8,000
15	Inner Mongolia Jiaquan Chemical Technology Co., Ltd.	15,000	5,000	6,000	6,000	6,000	7,000
	Others	149,000	27,000	22,800	24,700	21,000	23,100
	Total	667,000	273,000	283,800	295,200	308,600	302,700

Source:CCM

Figure 2.5-1 Capacity and output of PF in China, 2018–2022



Source:CCM

- Price of PF in recent years

At the beginning of 2015, the ex-works price of 96% PF saw a sharp decrease and hit the lowest level of the year in March 2015 at USD617/t. And then it recovered in April, reaching USD783/t. However, the price of PF started to decrease in May, falling to USD675/t in Dec. As the price of methanol and imported PF kept decreasing, the domestic ex-works price of PF decreased as well.

In 2016, the overall ex-works price of PF was lower than that in 2015. In Q1–Q3 2016, the ex-works price of PF declined from USD704/t in Jan. to USD559/t in Sept., mainly affected by its upstream raw materials' price fall (especially methanol). However, the ex-works price of PF began to increase in Q4 2016, due to the recovering demand for glyphosate.

In 2017, the average ex-works price of PF was higher than that in 2016. Throughout the year, the price of PF increased from USD662/t in Jan. to USD757/t by the end of the year. That was mainly affected by increasing costs of raw materials.

In 2018, the annual average ex-works price of PF continued to increase, reaching about USD897/t, the highest since 2010. Major reasons for the increase are high prices of formaldehyde and methanol, and production cuts in some PF producers triggered by stringent environmental protection inspections, especially in Shandong and Hebei.

In 2019, the annual average ex-works price of PF decreased by about USD154/t year on year.

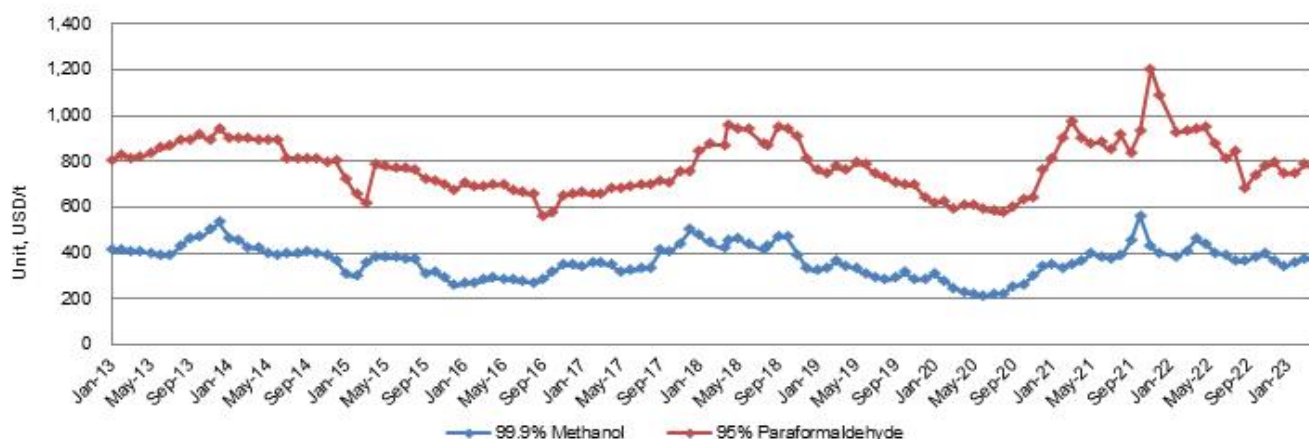
In 2020, due to the impact of the COVID-19 epidemic, and new set-ups of PF capacity, especially in West China and North China (cost advantage, less influence from environmental protection concerns), the price of PF dropped to the 2020 lowest point at USD571/t in Aug. Later, with rising raw material prices and increasing demand for PF, the PF price rebounded and kept rising. Especially at the end of 2020, amidst the continuous rise of methanol price, environmental protection restrictions in winter, high demand from downstream wood-based panel industry, and decreased supply and the rising price of formaldehyde, PF price jumped.

In 2021, due to a methanol price hike, PF market grew strongly with the ex-works price peaking at about USD1,200/t in Nov. The production cost of methanol increased since the price of coal was kept at a high level. In addition, prices of PF downstream products were moving up in 2021, especially the price of glyphosate, which also supported growth of PF prices to some extent.

In 2022, the ex-works price of PF saw a decline in general with some fluctuations. Due to shrinking methanol prices and sluggish demand, the market positivity was dampened to some extent.

China's PF price was basically stable in Q1 2023, recovering a bit thanks to increasing prices of raw materials.

Figure 2.5-2 Ex-works price of 99.9% methanol and 96% PF in China, Jan. 2013–March 2023



Source:CCM

- Import & export

China imported 23,000 tonnes–28,000 tonnes of PF annually in 2016–2021. In 2022, China's import volume of PF saw a sharp decrease compared with previous years, plunging to the lowest level in the past decade. Given insufficient downstream demand, high import prices and improved quality of domestic products, the domestic imports witnessed a decline. In contrast, the export volume kept on rising, thanks to strong demand amidst inadequate product availability overseas due to low production activities.

From 2012 to 2014, the export volume of PF from China kept increasing. However, it kept decreasing in 2015–2018, due to the decline in demand from resin production abroad. In 2019–2022, PF export from China saw significant year-on-year increases, reaching 46,989 tonnes in 2022. In 2021–2022, the top five export destinations of China's PF with a volume of over 3,000 tonnes were Djibouti, South Korea, Nigeria, Kenya and Myanmar.

Table 2.5-2 China's imports & exports of PF, 2013–2022

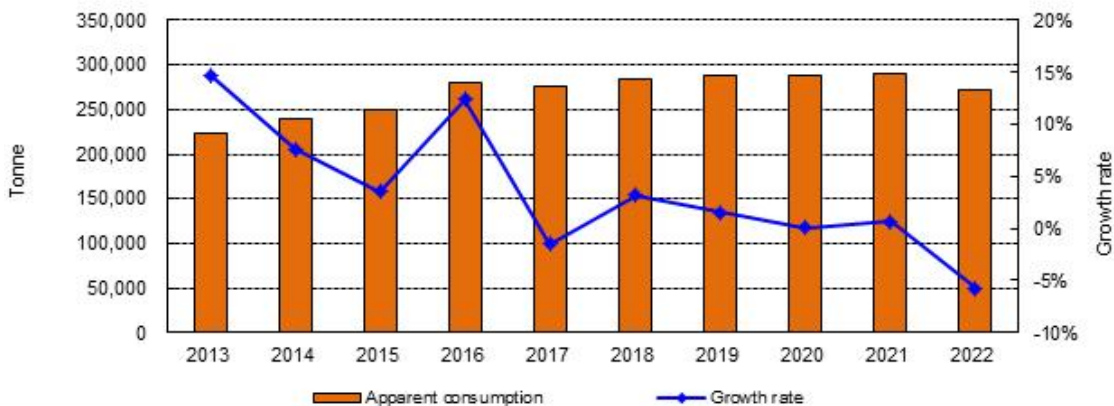
Year	Import			Export		
	Volume, tonne	Value, USD	Average price, USD/t	Volume, tonne	Value, USD	Average price, USD/t
2013	28,098	24,315,107	865	17,144	14,539,425	848
2014	23,695	21,321,657	900	18,244	16,440,267	901
2015	18,351	14,242,131	776	17,877	13,033,631	729
2016	27,228	16,693,127	613	17,478	10,253,062	587
2017	23,682	16,169,213	683	15,644	10,702,508	684
2018	25,216	19,396,069	769	13,837	11,752,717	849
2019	27,747	19,721,149	711	22,660	16,120,527	711
2020	21,952	13,785,257	628	28,157	16,271,518	578
2021	24,339	20,254,740	832	42,084	35,485,792	843
2022	16,718	17,202,637	1,029	46,989	39,715,532	845

Source:China Customs & CCM

- Consumption pattern of PF in China

On the whole, the apparent consumption of PF in China has increased at a CAGR of 2.2% during 2013–2022, though consumption in 2022 saw a year-on-year decline.

Figure 2.5-3 Apparent consumption of PF and its growth rate in China, 2013–2022



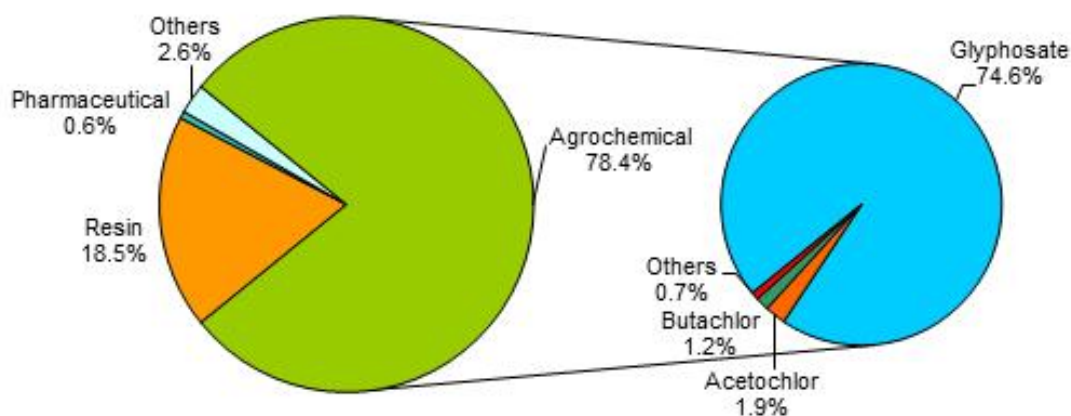
Source:CCM

- Consumption structure of PF in China

Agrochemical has kept being the largest end-use segment for PF in China, with the consumption of PF in this sector accounting for 78.4% of the national total in 2022, slashed by 1.1 percentage points year on year though. In this segment, PF is mainly consumed in glyphosate and amide herbicides, including acetochlor, butachlor, alachlor, and propisochlor.

The PF consumption volume in agrochemicals was 213,470 tonnes, including 203,200 tonnes consumed in glyphosate, 5,120 tonnes in acetochlor, 3,300 tonnes in butachlor and 1,850 tonnes in other agrochemicals.

Figure 2.5-4 Consumption of PF in China by end use segment, 2022



Source:CCM

- Consumption situation of PF in agrochemical industry

PF is mainly used to produce agrochemicals, such as glyphosate, acetochlor, butachlor, alachlor, etc.

Table 2.5-3 Consumption of PF in agrochemical industry in China, 2018–2022, tonne

Items	Unit consumption (kg/t)	2018	2019	2020	2021	2022
Glyphosate	490	95.2%	95.4%	95.3%	95.3%	95.2%
Acetochlor	200	2.6%	2.4%	2.5%	2.3%	2.4%
Butachlor	212	1.5%	1.5%	1.5%	1.6%	1.5%
Others	/	0.7%	0.7%	0.7%	0.8%	0.9%
Total	/	229,980	228,980	231,990	231,350	213,470

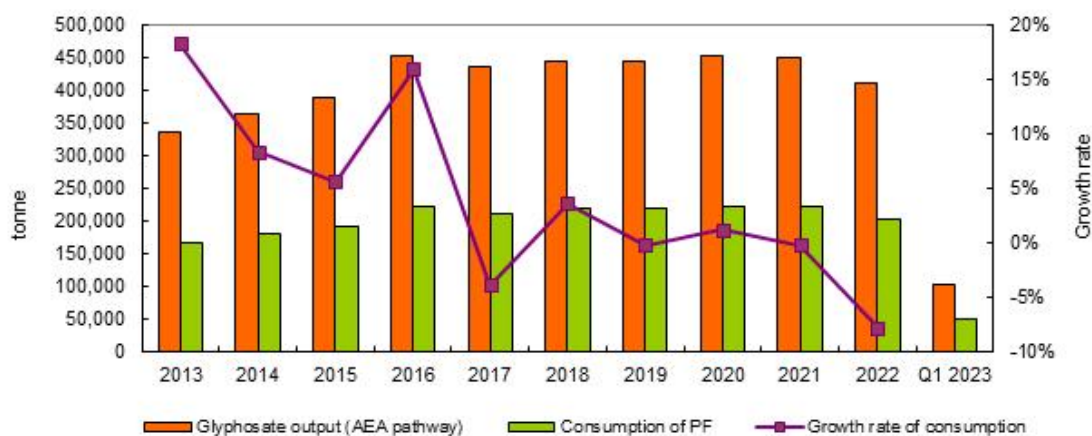
Source:CCM

Among agrochemicals, glyphosate is the largest PF consumption sector in China. Its PF consumption has been accounting for about 95% of the total PF consumption in agrochemicals in 2018–2022.

Glyphosate technical is mainly produced through two pathways, the AEA pathway and the IDA pathway, with the former consuming PF. Glyphosate production uses PF with a content of 95%–97% as the raw material. The production of one tonne of glyphosate through the AEA pathway needs to consume 0.45–0.51 tonne of PF.

In 2022, glyphosate output by the AEA pathway in China was 450,000 tonnes, consuming about 203,200 tonnes of PF.

Figure 2.5-5 Consumption of PF in glyphosate in China, 2013–Q1 2023



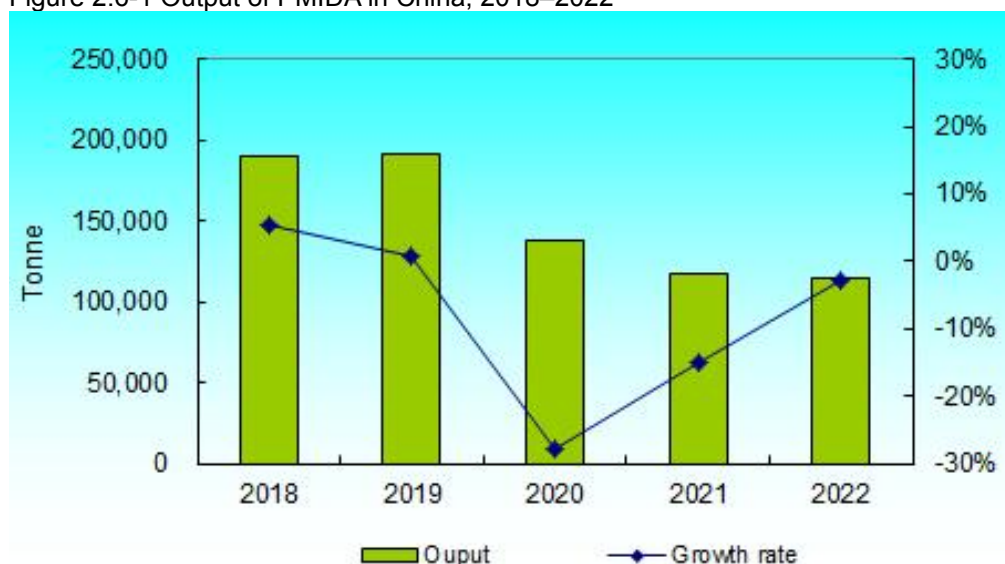
Source:CCM

2.6 PMIDA

There are two ways to obtain PMIDA in China, namely the DEA route and the IDAN route. The IDAN route takes up a greater output share because of its low cost and abundant supply.

Almost no homemade DEA is consumed to make PMIDA, and PMIDA producers prefer imported DEA because PMIDA produced with imported one is of good quality and low cost.

Figure 2.6-1 Output of PMIDA in China, 2018–2022



Source:CCM

Table 2.6-1 Capacity and output of PMIDA producers in China, 2018–2022

No.	Producer	Capacity in 2022, t/a	Output, tonne				
			2018	2019	2020	2021	2022
1	Leshan Hebang Agricultural Technology Co., Ltd.	180,000	155,900	173,000	120,000	114,000	105,000
2	ADAMA Ltd. (formerly Hubei Sanonda Co., Ltd.)	22,000	21,000	7,500	0	0	0
3	Inner Mongolia Unisplendour Chemical Co., Ltd.	20,000	3,000	2,500	2,000	1,000	1,000
4	Guang'an Chengxin Chemical Co., Ltd.	15,000	1,000	0	0	0	0
5	Taixing Feitian Chemical Co., Ltd.	10,000	1,000	1,000	4,000	2,500	1,000
6	Shanxian Runjin Biological Technology Co., Ltd.	5,000	700	0	0	0	0
7	Guangxi Yiduoshou Bio-technology Co., Ltd.	5,000	100	0	0	0	0
	Others	20,000	7,000	7,000	12,000	0	7,000
	Total	277,000	189,700	191,000	138,000	117,500	114,000

Source:CCM

Before 2014, domestically produced PMIDA (circulated in the market) was mainly for export. Since then, especially after the launch of Leshan Hebang's 135,000 t/a PMIDA installations, some domestic producers of glyphosate technical started to purchase homemade PMIDA instead of IDAN to produce glyphosate technical because of shortened production flow, reduced waste discharge, low cost with PMIDA as starting material and more and more PMIDA supply. Therefore, the domestic output of PMIDA (circulated in the market including both for domestic sales and export) increased rapidly from 119,000 tonnes in 2014 to 180,000 tonnes in 2017, with a CAGR of 14.8%.

The output grew slowly in 2018–2019, reaching 191,000 tonnes in 2019.

In 2020–2022, the output dropped significantly, to less than 120,000 tonnes in 2022, and the number of producers decreased from eight in 2018 to three in 2022. Among the producers, only Leshan Hebang have established a complete integrated chain of glyphosate (IDAN route), with a market share of more than 80%. This is mainly due to its advantages of easy access to natural gas and low raw material costs.

On 19 April, 2022, Leshan Hebang announced that it was planning to invest RMB12.5 billion to build 500,000 t/a PMIDA production line; On 28 October, 2022, the project commenced construction in the Xinqiao Chemical Industry Park in Guang'an City, Sichuan Province.

2.7 Impacts of raw materials on glyphosate industry

In this part, CCM will discuss the impact of raw materials on glyphosate industry from two aspects—supply and price, and important raw materials including glycine, DEA and IDAN will be analysed in detail.

- Glycine

Currently, the domestic supply of glycine greatly exceeds the domestic demand, with the operating rate of less than 60% in 2020–2021.

In addition, some glyphosate producers have achieved self-supply of glycine, and some planned to construct glycine production lines for their production of glyphosate technical, which further weakens the bargaining power of glycine producers.

- Hubei Trisun has a glycine capacity of 100,000 t/a.
- Fuhua Tongda has glycine production lines with a total capacity of 40,000 t/a.
- Henan HDF has a 15,000 t/a glycine production line.
- Inner Mongolia Xingfa has a 10,000 t/a glycine production line.

Nowadays, domestic glycine industry only has a small impact on domestic glyphosate industry in terms of supply and price. Conversely, the former is largely subject to the latter.

However, during some specific periods when the requirements for environmental protection are especially higher (state-level congresses held in Beijing, flood, frequent severe atmospheric haze in winter, etc.), the supply of glycine will be tense and its price will be high, which may raise the price of glyphosate technical to some extent.

- IDAN

Domestic glyphosate technical producers prefer purchasing PMIDA instead of purchasing IDAN, along with the launch of Leshan Hebang's 135,000 t/a of PMIDA installations since 2014 and stricter environmental protection requirements, and the volume of IDAN circulating in the domestic market declined.

The industrial concentration of IDAN is relatively high (only three producers), and it will be further heightened in the future, because Leshan Hebang has played a dominant role in IDAN & PMIDA industrial chain. Leshan Hebang also publicised that it proposed a 500,000 t/a PMIDA expansion plan in April 2022.

IDAN will have only a small impact on the domestic glyphosate industry in terms of supply and price in the future.

- DEA

There was only one company adopting DEA to produce PMIDA and then glyphosate technical currently.

Only the imported DEA, most of which is imported with the shipment mode of Processing with Imported Materials, is consumed in PMIDA & glyphosate technical. Therefore, the supply of homemade DEA has no influence on domestic glyphosate production.

DEA will have a small impact on the domestic glyphosate industry in the future.

3 Glyphosate supply

3.1 Glyphosate registration situation

Since the mid-1980s, glyphosate, one of the world's most popular herbicides, has been registered in China. It is now the herbicide with the most registrations in China. From Oct. 2016–March 2023, the number of active registrations for glyphosate increased gradually from 1,067 to 1,549 and registrants from 473 to 542.

Table 3.1-1 Registrations of glyphosate in China, as of Oct. 2016, Aug. 2017, Oct. 2018, Dec. 2019 , Feb. 2021 , March 2022 and March 2023

Specification		Number of registration						
		Oct. 2016	Aug. 2017	Oct. 2018	Dec. 2019	Feb. 2021	March 2022	March 2023
Single formulations	SL	517	547	638	631	631	659	663
	SP	136	140	144	144	144	144	142
	SG/WSG	163	168	219	219	219	231	231
Mixed formulations		93	121	217	231	239	357	364
Technical		158	152	157	152	151	151	149
Total		1,067	1,128	1,375	1,377	1,384	1,542	1,549

Source: Institute for the Control of Agrochemicals, Ministry of Agriculture (ICAMA) & CCM

- Registration of glyphosate technical

The number of companies that have registered glyphosate technical products has been on the rise in recent years, but new registrations dwindled, with eight in 2014, six in 2015, five in 2016, two in 2017 and two in 2018.

As of March 2023, there were 149 active registrations of glyphosate technical by 131 companies in total.

Table 3.1-2 Registrations of glyphosate technical by content in China, as of March 2023

Content	Number of registration
95%	128
96%	3
98%	4
97%	2
95%, 93%, 90%	1
Others	11
Total	149

Source: ICAMA & CCM

Table 3.1-3 Registrations of glyphosate technical by AI in China, as of March 2023

Active ingredient	Number of registration
Glyphosate acid	140
Glyphosate ammonium	5
Glyphosate potassium	2
Glyphosate dimethylammonium	2
Total	149

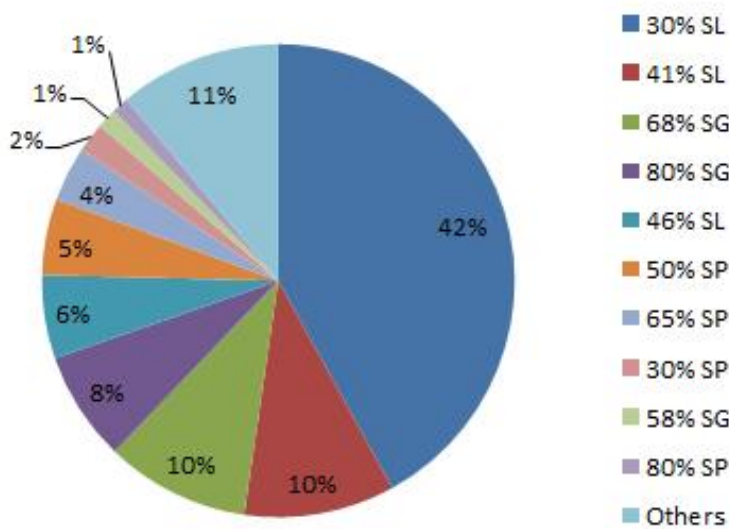
Source: ICAMA & CCM

- Registration of glyphosate formulations

As of March 2023, there were 506 companies obtaining 1,400 active registrations of glyphosate formulations, 1,036 of which were single formulations.

Formulation types registered in China include soluble concentrate (SL), soluble powder (SP), soluble granule/water soluble granule (SG/WSG), etc. Among them, SL is the major formulation, taking up over 60% of the total glyphosate formulation registrations.

Figure 3.1-1 Active registrations of single glyphosate formulations by specification in China, as of March 2023



Source: ICAMA & CCM

Table 3.1-4 Active registrations of single glyphosate formulations by specification in China, as of March 2023

Specification	Number of registration	Proportion in total registration
30% SL	435	42%
41% SL	107	10%
68% SG	102	10%
80% SG	78	8%
46% SL	59	6%
50% SP	54	5%
65% SP	39	4%
30% SP	21	2%
58% SG	14	1%
80% SP	12	1%
Others	115	11%
Total	1,036	100%

Source: ICAMA & CCM

There existed about 62 specifications of registered single formulations in China as of March 2023. Among the current 1,036 active registrations of single formulations, 965 are registered with the registration name of "glyphosate" only; it's difficult to judge what AIs (IPA, ammonium, potassium, etc.) they are.

Some Chinese companies unfairly promoted their glyphosate formulations (the same content, low price, but different AI) and competed with other formulation suppliers by means of concept confusion (AI and content).

Picture 3.1-1 Registrations of single glyphosate formulations by specification in China, as of March 2023
Glyphosate is mainly mixed with MCPA, dicamba, 2,4-D, fluoroglyphofen-ethyl, fluroxypyr, triclopyr, bensulfuron-methyl, etc. There were 121 active registrations of mixed formulations as of Aug. 2017, and it increased rapidly to 217 in Oct. 2018 and then climbed little by little to 364 by March 2023.

Source: ICAMA & CCM

3.2 Glyphosate technical

3.2.1 Total supply

In 2022, the domestic capacity of glyphosate technical was 830,000 t/a, and the output reached about 595,000 tonnes.

Table 3.2.1-1 Capacity and output of glyphosate technical in China, 2013–2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Capacity, t/a	906,500	909,500	998,500	999,000	905,000	805,000	795,000	795,000	800,000	830,000
Output, tonne	512,000	534,000	520,000	600,000	600,000	605,000	590,000	595,000	604,000	595,000

Source: CCM

3.2.2 Supplier

The number of glyphosate technical suppliers (idle included) showed a downward trend after 2010, and it decreased sharply from 58 in 2010 to 33 in 2015, 18 in 2018, 17 in 2019–2021 and 16 in 2022 caused by the sluggish market, low price, poor profit, unfavourable policies (high requirement for waste treatment, cancellation of VAT, EPV), etc.

Fuhua Tongda Chemical Co., Ltd.

Fuhua Tongda is the top glyphosate technical producer in China in terms of both capacity and output. The company is self-sufficient in some raw materials including liquid chloride, coal, yellow phosphorus, 200,000 t/a of ionic membrane caustic soda, 180,000 t/a of phosphorus trichloride, 120,000 t/a of DMP, 40,000 t/a glycine, 60,000 t/a of PF, 37,500 kW of thermoelectric station, 220 t/h of steam supply stations, etc.

In April 2022, Fuhua Tongda acquired 24.19% shares of Nantong Jiangshan. Nantong Jiangshan has three glyphosate production lines with the capacity of 30,000 t/a (glycine route), 15,000 t/a (IDAN route) and 25,000 t/a (IDAN route) separately.

Nantong Jiangshan is self-sufficient in some raw materials including 220,000 t/a of hydrochloric acid 31%, 160,000 t/a of caustic soda, 160,000 t/a of phosphorus trichloride, 40,000 t/a of DMP, 137,800 t/a of phosphorous acid 30%, etc.

Hubei Trisun Chemicals Co., Ltd.

Hubei Trisun, 100% share held by Hubei Xingfa Chemicals Group Co., Ltd., is one of the largest glyphosate technical producers, with glyphosate technical capacity only next to Fuhua Tongda in China.

Hubei Trisun mainly produces glyphosate technical (130,000 t/a), glyphosate formulations (40,000 t/a), methylal (35,000 t/a), methyl chloride (130,000 t/a) and phosphorous acid solution (5,000 t/a). It also produces key upstream products of glyphosate technical, including phosphorus trichloride (190,000 t/a), DMP (130,000 t/a) and glycine (100,000 t/a).

Some raw materials are supplied by its sister companies. For example, yellow phosphorus is supplied by Hubei Xingrui Chemical Co., Ltd. and Guangxi Xingfa Chemical Co., Ltd. Moreover, as a sister company of Hubei Trisun, Inner Mongolia Xingfa Technology Co., Ltd.'s glyphosate technical production capacity has increased to 100,000 t/a, since its new 50,000 t/a glyphosate technical production line was completed and put into operation at the end of 2022.

Zhejiang Wynca Chemical Industrial Group Co., Ltd.

Zhejiang Wynca is one of the key glyphosate producers in China with the glyphosate technical capacity of 80,000 t/a. The company has two glyphosate plants: one is located in Jiande City of Zhejiang Province, and the other is located in Zhenjiang City of Jiangsu Province.

Zhejiang Wynca adopts the AEA pathway only, and the company tops in cost control among all glyphosate producers who adopt the AEA pathway in China. Zhejiang Wynca is the company which first developed the industrial chain of glyphosate-chloromethane-organosilicon and applied for the patent.

Table 3.2.2-1 Basic info of glyphosate technical manufacturers in China

No.	Company	Abbreviation	Location	Launch time	Status in 2022
1	Fuhua Tongda Agro-chemical Technology Co., Ltd.	Fuhua Tongda	Sichuan	2002	Active
	Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.	Nantong Jiangshan	Jiangsu	1992	Active
2	Hubei Trisun Chemicals Co., Ltd.	Hubei Trisun	Hubei	2007	Active
	Inner Mongolia Xingfa Technology Co., Ltd.	Inner Mongolia Xingfa	Inner Mongolia	2013	Active
3	Zhejiang Wynca Chemical Industrial Group Co., Ltd.	Zhejiang Wynca	Zhejiang	1987	Active
	Zhenjiang Jiangnan Chemical Co., Ltd.	Zhenjiang Jiangnan	Jiangsu	1987	Active
4	Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	Jiangsu Good Harvest	Jiangsu	1999	Active

5	Leshan Hebang Agricultural Science and Technology Co., Ltd.	Leshan Hebang	Sichuan	2015	Active
6	Jiangsu Yangnong Chemical Co., Ltd.	Jiangsu Yangnong	Jiangsu	2008	Active
7	Henan HDF Chemical Co., Ltd.	Henan HDF	Henan	2013	Active
8	Jiangxi Jinlong Chemical Co., Ltd.	Jiangxi Jinlong	Jiangxi	2008	Active
9	Anhui Dongzhi Guangxin Agrochemical Co., Ltd.	Anhui Dongzhi Guangxin	Anhui	2007	Active
10	Guang'an Chengxin Chemical Co., Ltd.	Guang'an Chengxin	Sichuan	2014	Active
11	Jingma Chemicals Co., Ltd.	Jingma Chemicals	Zhejiang	1980	Active
12	ADAMA Ltd.	ADAMA	Hubei	1994	Idle

Source:CCM

Table 3.2.2-2 Capacity and output of glyphosate technical by producer in China, 2018–2022

No.	Company	Capacity in 2022, t/a	Output, tonne				
			2018	2019	2020	2021	2022
1	Fuhua Tongda	153,000	126,000	129,000	123,000	126,000	130,000
	Nantong Jiangshan	70,000	66,000	62,000	63,000	62,000	60,000
2	Hubei Trisun	130,000	110,000	110,000	115,000	122,000	120,000
	Inner Mongolia Xingfa	100,000	29,000	35,000	36,000	28,000	40,000
3	Zhejiang Wynca	30,000	31,000	31,000	31,000	30,000	25,000
	Zhenjiang Jiangnan	50,000	50,000	50,000	50,000	50,000	45,000
4	Jiangsu Good Harvest	62,000	38,000	30,000	30,000	30,000	26,000
5	Leshan Hebang	50,000	55,000	55,000	50,000	55,000	50,000
6	Jiangsu Yangnong	35,000	32,000	30,000	30,000	30,000	30,000
7	Henan HDF	30,000	28,000	18,000	27,000	25,000	23,000
8	Jiangxi Jinlong	20,000	20,000	20,000	20,000	20,000	20,000
9	Anhui Dongzhi Guangxin	20,000	20,000	20,000	20,000	19,000	19,000
10	Guang'an Chengxin	20,000	0	0	0	1,000	1,000
11	Jingma Chemicals	15,000	0	0	0	6,000	6,000
12	ADAMA	20,000	0	0	0	0	0
Others		25,000	0	0	0	0	0
Total		830,000	605,000	590,000	595,000	604,000	595,000

Source:CCM

3.2.3 Production by region

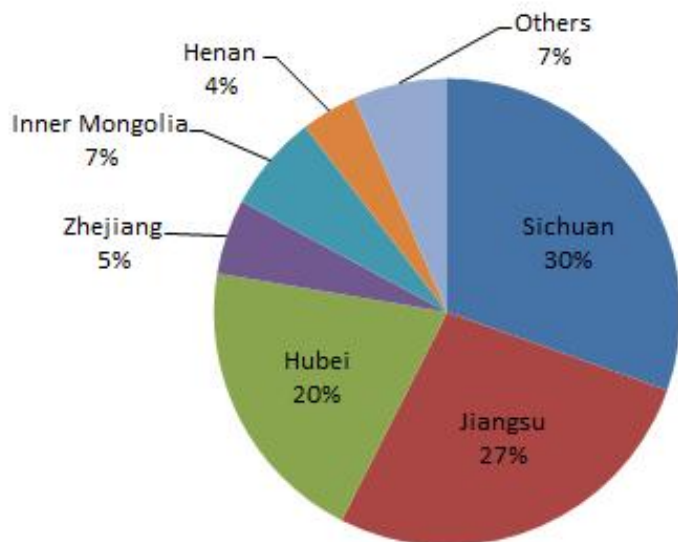
Jiangsu Province was the largest production region of glyphosate technical in China before 2019, but Sichuan Province came to the top in 2019.

Table 3.2.3-1 Capacity and output of glyphosate technical in China by region, 2018–2022

Province/region	Capacity, t/a					Output, tonne				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Sichuan	213,000	213,000	213,000	223,000	223,000	181,000	184,000	173,000	182,000	181,000
Jiangsu	257,000	257,000	257,000	237,000	217,000	186,000	172,000	173,000	172,000	161,000
Hubei	150,000	150,000	150,000	150,000	150,000	110,000	110,000	115,000	122,000	120,000
Zhejiang	30,000	30,000	30,000	45,000	45,000	31,000	31,000	31,000	36,000	31,000
Inner Mongolia	50,000	50,000	50,000	50,000	100,000	29,000	35,000	36,000	28,000	40,000
Henan	30,000	30,000	30,000	30,000	30,000	28,000	18,000	27,000	25,000	23,000
Jiangxi	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Anhui	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	19,000	19,000
Others	35,000	25,000	25,000	25,000	25,000	0	0	0	0	0
Total	805,000	795,000	795,000	800,000	830,000	605,000	590,000	595,000	604,000	595,000

Source:CCM

Figure 3.2.3-1 Output share of glyphosate technical in China by region, 2022



Source:CCM

3.2.4 Production by production route

Table 3.2.4-1 Capacity of glyphosate technical in China by production route, 2013–2022

Production route		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
AEA	Capacity, t/a	552,000	550,000	645,000	648,000	603,000	558,000	548,000	548,000	548,000	578,000	
	Number of producers	23	22	18	16	15	12	11	11	11	10	
IDA	DEA route	Capacity, t/a	85,000	80,000	65,000	65,000	60,000	55,000	55,000	55,000	35,000	35,000
		Number of producers	5	4	3	3	3	2	2	2	1	1
	IDAN route	Capacity, t/a	259,500	269,500	278,500	286,000	242,000	192,000	192,000	192,000	217,000	217,000
		Number of producers	22	22	15	13	10	6	6	6	7	7
	PMIDA route	Capacity, t/a	10,000	10,000	10,000	0	0	0	0	0	0	0
		Number of producers	1	1	1	0	0	0	0	0	0	0
Total	Capacity, t/a	906,500	909,500	998,500	999,000	905,000	805,000	795,000	795,000	800,000	830,000	
	Number of producers	47	46	33	28	24	18	17	17	17	16	

Source:CCM

Table 3.2.4-2 Output of glyphosate technical in China by production route, 2013–2022

Production route		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
AEA	Output, tonne	336,300	361,800	387,100	451,000	437,900	444,000	442,000	452,000	449,000	450,000	
	Growth rate	16.2%	7.6%	7.0%	16.5%	-2.9%	1.4%	-0.5%	2.3%	-0.7%	0.2%	
	Operating rate	60.9%	65.8%	60.0%	69.6%	72.6%	79.6%	80.7%	82.5%	81.9%	77.9%	
IDA	DEA route	Output, tonne	53,500	45,000	26,000	26,000	26,000	30,000	30,000	30,000	30,000	30,000
		Growth rate	18.9%	-15.9%	-42.2%	0.0%	0.0%	15.4%	0.0%	0.0%	0.0%	0.0%
		Operating rate	62.9%	56.3%	40.0%	40.0%	43.3%	54.5%	54.5%	54.5%	85.7%	85.7%
	IDAN route	Output, tonne	122,200	127,200	106,900	123,000	136,100	131,000	118,000	113,000	125,000	115,000
		Growth rate	28.0%	4.1%	-16.0%	15.1%	10.7%	-3.7%	-9.9%	-4.2%	10.6%	-8.0%
		Operating rate	47.1%	47.2%	38.4%	43.0%	56.2%	68.2%	61.5%	58.9%	57.6%	53.0%

Total	Output, tonne	512,000	534,000	520,000	600,000	600,000	605,000	590,000	595,000	604,000	595,000
	Growth rate	19.1%	4.3%	-2.6%	15.4%	0.0%	0.8%	-2.5%	0.8%	1.5%	-1.5%
	Operating rate	56.5%	58.7%	52.1%	60.1%	66.3%	75.2%	74.2%	74.8%	75.5%	71.7%

Source:CCM

3.3 Glyphosate formulations

3.3.1 Overview

The solubility of glyphosate technical is quite weak (1.2% at 25°C). But glyphosate salts have good solubility in the water without losing activity. For instance, the solubility of both glyphosate-isopropylammonium (IPA) and glyphosate sodium is 500 g/L, and the solubility of glyphosate ammonium is 300 g/L. Therefore, in actual application, glyphosate is converted into the following formulations: soluble concentrate (SL), soluble granule (SG)/water soluble granule (WSG) and soluble powder (SP).

Table 3.3.1-1 Key glyphosate formulations in China

Type of formulation	Active ingredient (AI)	Common name
Soluble concentrate (SL)	41% glyphosate IPA	41% IPA
		30% SL (glyphosate acid equivalent)
	33% glyphosate ammonium	30% SL (glyphosate acid equivalent)
	51% glyphosate IPA	51% IPA
		51% SL
		450 g/L SL (glyphosate acid equivalent)
	55% glyphosate IPA	41% SL (glyphosate acid equivalent)
	62% glyphosate IPA	62% IPA
		46% SL (glyphosate acid equivalent)
	50% glyphosate-K	50% SL
41% SL (glyphosate acid equivalent)		
540 g/L SL (glyphosate acid equivalent)		
Others (glyphosate ammonium, glyphosate dimethylammonium, glyphosate-Na, etc.)	30% SL, 35% SL, 41% SL, etc.	
Soluble granule (SG) / water soluble granule (WSG)	75.7% glyphosate ammonium	68% WSG (glyphosate acid equivalent)
		75.7% WSG
	88% glyphosate ammonium	80% SG (glyphosate acid equivalent)
	Others (glyphosate ammonium, glyphosate-K, etc.)	50% SG, 58% SG, 63% SG, 70% SG, etc.

Soluble powder (SP)	55% glyphosate ammonium	50% SP (glyphosate acid equivalent)
	71.5% glyphosate ammonium	65% SP (glyphosate acid equivalent)
	72% glyphosate ammonium	
	33% glyphosate ammonium	30% SP (glyphosate acid equivalent)
	Others (glyphosate ammonium, glyphosate-Na, etc.)	58% SP, 80% SP, etc.

Note: Mixed formulations are excluded.

Source: ICAMA & CCM

Among various glyphosate formulations, the activity is shown as follows: glyphosate-K > glyphosate IPA > glyphosate ammonium > glyphosate-Na. In China, glyphosate IPA and glyphosate ammonium are the key types of formulations produced, and the output of glyphosate-K and glyphosate-Na is very limited. Glyphosate IPA is mainly produced in the form of soluble concentrate, and glyphosate ammonium is produced in all these three forms including soluble concentrate, soluble granule and soluble powder.

Key glyphosate formulations produced in China include 30% SL (41% IPA mainly), 62% SL (62% IPA), 68% SG (75.7% WSG), 51% SL (51% IPA), 50% SP, and 80% SG (ranked in descending order of output in general).

There are over 300 suppliers of glyphosate formulations in China. Almost all glyphosate technical producers manufacture glyphosate formulations as well, and 51% SL is produced by glyphosate technical producers only.

These glyphosate formulation producers (producers of both technical and formulations excluded) are greatly subject to influences from those glyphosate technical producers, especially when the price of glyphosate technical is high, since they need to purchase glyphosate technical to produce various glyphosate formulations.

Domestic production of glyphosate formulations is mainly impacted by the export (overseas purchasing), and output of some glyphosate formulations fluctuates greatly from year to year.

Table 3.3.1-2 Output of key glyphosate formulations in China, 2018–2022, tonne

Year	30% SL (41% IPA mainly)	51% SL (51% IPA)	62% SL (62% IPA)	68% SG (75.7% WSG)	Others
2018	664,000	36,000	56,000	64,000	6,000
2019	667,000	35,000	62,500	70,000	6,100
2020	706,000	41,000	65,200	85,200	6,200
2021	720,000	35,000	120,000	71,500	6,300
2022	710,000	31,000	105,000	78,000	6,500

Source: CCM

3.3.2 Introduction to specific formulations

- Soluble concentrate (SL)

Key soluble concentrates produced in China include 30% SL, 51% IPA and 62% IPA.

33% glyphosate ammonium and 41% IPA are two major sub-types of 30% SL. In China, 30% SL (41% IPA mainly) is the most popular specification.

However, glyphosate 41% IPA made in China has the following drawbacks compared to overseas products:

- It is not transparent and tends to form floater and deposit.
- There is too much foam, which does not disappear easily, making it difficult for plants to absorb glyphosate, resulting in relatively poor efficacy.
- The concentration of adjuvant is below CMC (carboxy methyl cellulose), so the full use of physical properties of adjuvant cannot be made.

The quality of adjuvant has been improved and most Chinese producers have grasped the technology to blend the mixture properly, and 41% IPA manufactured in China becomes competitive in the international market because of low price and better quality than before.

Seeing increasing demand at home and abroad, domestic 30% SL (41% IPA mainly) output has increased greatly from less than 100,000 tonnes before 2006 to over 500,000 tonnes after 2014 and more than 600,000 tonnes after 2017.

Domestic production of 30% SL is mainly grasped by suppliers of glyphosate technical, with their output of 30% SL accounting for over 90% of China's total.

51% IPA (450g/L SL), produced by glyphosate technical producers only, is meant for Australia and New Zealand markets. Key 51% IPA producers include Jiangsu Good Harvest, Nantong Jiangshan, Shandong Rainbow, Zhenjiang Jiangnan, etc.

62% IPA is mainly produced for export, and only a small portion is consumed in the domestic market. Key 62% IPA producers include Shandong Rainbow, Zhejiang Jinfanda, Zhejiang Wynca, Nantong Jiangshan, Jiangsu Good Harvest, Fuhua Tongda, etc.

- Soluble granule (SG)/water soluble granule (WSG)

Main (W)SG forms of glyphosate produced in China include 68% (W)SG, 80% (W)SG, etc. (W)SG forms are produced for export mainly, and their domestic demand is limited. The annual consumption of (W)SG forms in China is estimated at 1,000 tonnes–2,000 tonnes, and key players include Zhejiang Wynca, Zhejiang Jinfanda, Jiangsu Weien, Shandong Rainbow, etc.

- Soluble powder (SP)

The main SP forms of glyphosate produced in China include 30% SP, 50% SP, and 65% SP. SP forms are mainly consumed in China, and the demand is also limited. It is estimated that only about 2,000 tonnes–4,000 tonnes of glyphosate in SP forms are produced in China annually, and key players include Zhejiang Wynca, Jiangsu Kuaida, Jiangsu Good Harvest, Nantong Feitian Chemical Industrial Co., Ltd., Anhui MKD Agrochemical Co., Ltd., etc.

3.3.3 China's glyphosate formulation trend and its impacts on global market

30% SL (mainly 41% IPA) to keep a dominant role

Since 2010, along with the ban of 10% SL, 30% SL (41% IPA mainly) seized more and more market share, playing a dominant role in the domestic glyphosate market. The trend will keep its momentum, mainly attributed to the following reasons:

Firstly, the domestic demand for glyphosate kept increasing, especially after 2016, along with the ban on paraquat AS formulations.

Secondly, the active ingredient of 30% SL (41% IPA mainly) is glyphosate-isopropylammonium, whose activity is only second to glyphosate-potassium, and the R&D of glyphosate-potassium is still at its infant stage.

Thirdly, solid formulations application in China is far less than that of 30% SL (41% IPA mainly), due to less promotion and higher technical requirements. Therefore, solid formulations, such as WSG, will not pose threat to the domination of 30% SL (41% IPA mainly) in the short term.

Solid formulations to foresee promising market in the long term

Though the output and consumption volume of solid formulations are far less than those of SL formulations at present, glyphosate solid formulations will see a promising market in the long term, as China's export volume of glyphosate 75.7% WSG has increased rapidly in the past few years, indicating its brisk demand and rapid growth in overseas market.

Impacts of China's formulation development on global market

More glyphosate formulations consumed in the world will be directly produced in China. However, it is hard to define that homemade glyphosate formulations will have great impacts on global market in the following few years. The main reasons are as follows:

- Firstly, there are many barriers such as strict quality certification, application patent, etc. for Chinese producers to register glyphosate formulations in overseas countries, all of which have blocked the first step for Chinese glyphosate formulations to enter the overseas market.
- Secondly, it's estimated that Chinese adjuvant quality can't make significant progress in the next five years, which leads to lower quality of products using domestic adjuvants than that of overseas products.
- Thirdly, domestic glyphosate producers do not have comprehensive sales channels and rich marketing experience in the overseas market. Moreover, they will face intense competition from overseas local suppliers whose sales channel has already been established locally.

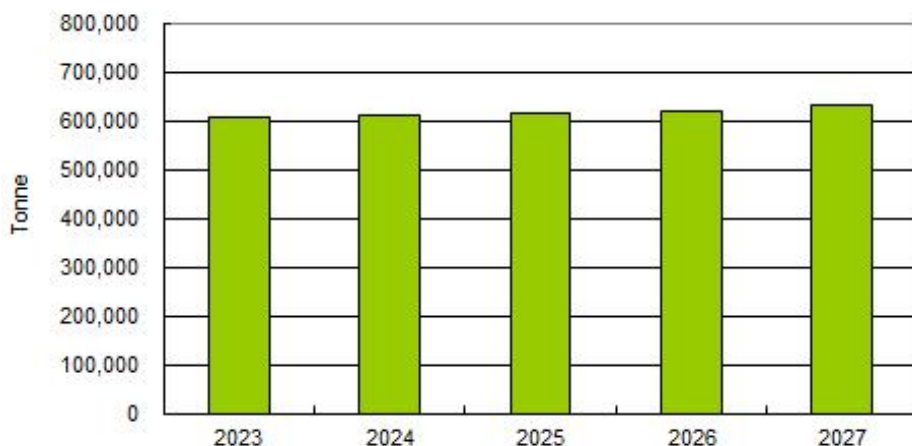
3.4 Forecast on glyphosate supply in the next five years

The number of producers of glyphosate technical in China decreased to only 16 in 2018–2022. Inner Mongolia Xingfa's 50,000 t/a glyphosate expansion project has been put into operation at the end of 2022, making Xingfa Group's glyphosate capacity expand to 230,000 t/a; meanwhile, CAC Nantong revealed that the company's 20,000 t/a glyphosate technical production line will no longer resume production. Therefore, by the end of 2022, the domestic capacity of glyphosate technical has reached 830,000 t/a.

In 2022, the output of glyphosate technical in China decreased by 1.49% from 2021. In the first half of 2022, the domestic output and sales of glyphosate technical were positive, but in the second half of the year, affected by national policy regulation and weak downstream demand, the relevant manufacturers started to reduce the production of glyphosate in the fourth quarter by means of rotating maintenance of production units.

Key factors influencing China's glyphosate technical supply include global demand and overseas supply. In recent years, the increase in global concern for food security has pushed up the profitability and willingness to grow crops worldwide, driving up the demand for pesticides globally. Meanwhile, the continuous promotion of genetically modified crops and the expansion of planting area have prompted changes in the product structure of the pesticide industry, and pesticides adapted to genetically modified crops will become mainstream products. Therefore, driven by the strong demand for glyphosate technical in the global market, it is expected that the output of glyphosate technical in China will further increase, reaching 630,000 tonnes in 2027 with a CAGR of 1.0% from 2023.

Figure 3.4-1 Forecast on glyphosate technical output in China, 2023–2027



Source:CCM

4 Trade analysis

4.1 Trade position in the world

China is an important player in the worldwide market of glyphosate.

China was a main raw material (glyphosate technical and PMIDA) supplier for glyphosate series in the world before, but the situation has changed in 2011. From then on, the export volume of glyphosate formulations increased rapidly and exceeded that of glyphosate technical by growing margins.

Table 4.1-1 China's export volume of glyphosate technical and formulations and PMIDA in 2016–2022, tonne

Year	Glyphosate technical	Glyphosate formulation	PMIDA
2016	313,710	499,167	61,155
2017	293,165	552,012	66,260
2018	300,854	521,982	57,066
2019	275,968	516,751	46,728
2020	299,367	368,703	37,276
2021	321,694	287,685	42,779
2022	269,767	275,181	21,152

Note: Data of glyphosate formulation in 2022 only includes the exports to major export destinations; data of glyphosate formulation of other years include the exports to all destinations.

Source: China Customs & CCM

Major glyphosate technical players in the world are mainly concentrated in China, the US, Argentina, Brazil, India, etc. China is the biggest exporter of glyphosate technical with the total export volume of 275,968 tonnes in 2019, 299,367 tonnes in 2020, 321,694 in 2021 and 269,767 in 2022.

Currently, the global capacity of glyphosate technical is about 1,200,000 t/a, and the capacity is relatively concentrated. In 2022, China's capacity of glyphosate technical was 830,000 t/a, accounting for 69% of the total global capacity.

Only China, the US and Brazil supply PMIDA in the global market. Among them, China is the biggest exporter, but the export volume was at a historical low, mainly due to the rebound of the COVID-19.

4.2 Trade barriers involving Chinese glyphosate

In recent years, China's international trade has faced challenges, mainly from anti-dumping and tariff barriers.

Anti-dumping

Many countries and regions, such as Australia, Brazil and the EU, have implemented anti-dumping investigations against Chinese glyphosate products in order to protect their own glyphosate industry. Most initiations of such investigations concentrated before 2013, and by now, Chinese glyphosate industry has basically overcome obstacles caused by the anti-dumping tax. Chinese-made glyphosate stays competitive in the global market.

Tariff barriers

The US-China Trade War of 2018 has resulted in a 25% additional tariff of the US on USD50 billion worth of imports from China and China's responsive 25% tariffs on some of the US's goods, which is accompanied by price increase and volume decline of China's soybean imports from the US, and has had impacted the US's demand for Chinese glyphosate with increasing soybean stock in the country. China is the world's largest soybean importer. Before the US-China trade conflict, China registered about one-third of its soybean imports from the US, which represented about 60% of the US's total soybean exports.

Though weakening glyphosate trade between China and the US, the tariff barriers have induced China's attention to upgrade its agricultural production of soybean, corn and other crops, to reduce its imports, and has facilitated China's trade relations with other countries, for example with the major exporters of agricultural products Brazil.

Brazil is one of the three major soybean-producing countries in the world, accounting for about 35% of the world's soybean stock, and is now China's biggest soybean trading partner. The acreage of soybeans in Brazil has continued to increase in recent years, exceeding 100 million acres for the first time in 2022, which will help improve China's exports of glyphosate products to Brazil.

4.3 Export situation of PMIDA and glyphosate

- Export destination and exporter of PMIDA

Only a few countries in the world import PMIDA. China's PMIDA is mainly exported to Argentina, India and the US.

Leshan Hebang Agricultural Technology Co., Ltd. (Leshan Hebang), a key exporter of PMIDA in China, is currently the world's largest supplier of PMIDA, accounting for 70% of the global market share.

Table 4.3-1 Export value of glyphosate and PMIDA in China, 2016–2022

Year	Export value, million USD		
	Glyphosate technical	Glyphosate formulation	PMIDA
2016	907	816	97
2017	1,001	1,014	138
2018	1,198	1,140	134
2019	1,011	1,027	106
2020	811	665	76
2021	1,568	667	148
2022	2,816	451	121

Source: China Customs & CCM

Table 4.3-2 Export volume of PMIDA from China to main destinations in 2022, tonne

Exporters	Argentina	India	The US	Mexico	Egypt	Hong Kong, China	Total
Leshan Hebang Agricultural Technology Co., Ltd.	7,745	4,233	0	0	0	0	11,978
China Jiangsu International Economic and Technical Cooperation Group, Ltd.	2,439	1,998	0	72	0	0	4,509
Dongying Shanmei Trade Co., Ltd.	648	0	0	0	0	0	648
Shanghai Agrotree Chemical Co., Ltd.	0	360	0	0	0	0	360
Guang'an Chengxin Chemical Co., Ltd.	0	0	288	0	0	0	288
Shanghai Spring International Trade Co., Ltd.	176	0	0	0	0	0	176
Hangzhou Nutrichem Co., Ltd.	0	0	0	36	0	0	36
Others	2,628	5	0	0	11	513	3,157
Total	13,636	6,596	288	108	11	513	21,152

Source: China Customs & CCM

Table 4.3-3 Export volume of PMIDA from China to main destinations in 2021, tonne

Exporters	Argentina	India	The US	Egypt	Malaysia	Total
Leshan Hebang Agricultural Technology Co., Ltd.	12,566	7,358	9,108	0	18	29,050
China Jiangsu International Economic and Technical Cooperation Group, Ltd.	4,401	1,548	1,630	0	0	7,579
Dongying Shanmei Trade Co., Ltd.	2,883	54	0	0	0	2,937
Shanghai Spring International Trade Co., Ltd.	1,210	882	0	0	0	2,092
Shanghai Yancui Import and Export Corporation	0	612	0	0	0	612
C&D (Hainan) Co., Ltd.	0	216	0	0	0	216
Shanghai Agrotree Chemical Co., Ltd.	0	144	0	0	0	144
Dongying Yongxing Chemical Co., Ltd.	0	0	55	0	0	55
Shandong Qiaochang Modern Agriculture Import & Export Co., Ltd.	0	0	18	0	0	18
Others	0	0	0	78	0	78
Total	21,059	10,814	10,810	78	18	42,779

Source: China Customs & CCM

Table 4.3-4 Export volume of PMIDA from China to main destinations in 2020, tonne

Exporters	Argentina	India	The US	Egypt	Taiwan, China	Total
Leshan Hebang Agricultural Technology Co., Ltd.	9,252	4,867	17	0	0	14,136
Dongying Shanmei Trade Co., Ltd.	8,914	360	0	0	0	9,274
China Jiangsu International Economic and Technical Cooperation Group, Ltd.	6,354	486	0	0	0	6,840
DesiSage (Shanghai) Trade Co., Ltd.	3,913	0	0	0	0	3,913
Kunshan Microchem Specialties Co., Ltd.	907	306	0	0	0	1,213
Hangzhou Nutrichem Co., Ltd.	828	0	0	0	0	828
Shanghai Spring International Trade Co., Ltd.	252	432	0	0	0	684
Inner Mongolia Unisplendour Chemical Co., Ltd.	277	0	0	0	0	277
HK Gonghui Trading Co., Ltd.	0	36	0	0	0	36
Willowood (Hangzhou) Co., Ltd.	0	36	0	0	0	36
Hangzhou Hongqin Pharmaceutical Technology Co., Ltd.	0	18	0	0	0	18
Ceres Chemical Enterprises Limited	0	0	0	11	0	11
Dongying Yongxing Chemical Co., Ltd.	0	0	9	0	0	9
Shandong Binnong Technology Co., Ltd.	0	0	0	0	1	1
Total	30,697	6,541	26	11	1	37,276

Source: China Customs & CCM

- Export of glyphosate products

In general, major export destinations of China's glyphosate technical include the US, Brazil, Argentina, Russia, India, Paraguay, Indonesia, Australia, Nigeria and Malaysia, and those of glyphosate formulations are Brazil, the US, Ghana, the Philippines, Uganda, Nigeria, etc. South America has been the top destination continent of China's glyphosate.

In 2020–2022, Nigeria is China's top export destination of 41% glyphosate IPA in terms of the total volume, and Australia and the US have been China's top export destinations of 51% glyphosate IPA and 62% glyphosate IPA respectively. During this period, Brazil is China's top export destination of 75.7% glyphosate WSG as well as the glyphosate technical.

From 2020 to 2022, the prices of glyphosate products (including technical and formulations) exported from China continued to rise due to factors such as low inventory, limited new production capacity, and strong demand. It is worth noting that the compound growth rate of glyphosate technical export price reached 96.28%.

During 2022, the export volume of glyphosate products in China remained stable in the first half of the year. However, starting from the third quarter, the export volume and export prices of glyphosate products continued to decline due to the rebound of the COVID-19 and the restriction and suspension of production by manufacturers.

Table 4.3-5 Export volume of China's glyphosate by continent, 2020–2022, thousand tonne

Continent	2020	2021	2022
South America	194	213	213
North America	60	99	137
Asia	64	54	48
Africa	32	22	48
Europe	21	34	24
Oceania	41	23	6

Note: 1. Both technical and formulations are included and converted to 95% technical.

2. Data was based on top 20 destinations in 2020–2022.

Source: China Customs & CCM

Table 4.3-6 China's exports of glyphosate 41% IPA to major destinations, 2020–2022

2022			2021			2020		
Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg
Ghana	15,230	3.37	Ghana	18,033	0.96	Nigeria	30,784	1.34
Brazil	12,403	3.49	Nigeria	12,050	1.72	Ghana	16,575	1.25
Nigeria	11,359	3.78	The Philippines	8,545	1.77	The Philippines	12,580	1.4
The Philippines	8,533	2.46	Uruguay	5,716	N/A	Uganda	11,086	1.52
Uganda	6,219	3.65	Uganda	5,566	2.62	Ukraine	6,459	1.54
Tanzania	3,312	3.33	Peru	3,702	2.23	Peru	6,403	1.37
Peru	3,159	4.05	Pakistan	3,465	2	Uruguay	6,134	0.63
Thailand	2,384	3.60	Brazil	2,982	3.25	Canada	5,855	1.66
The US	2,382	3.89	Ukraine	2,982	2.59	Russia	5,782	1.58
Ecuador	2,382	3.61	Russia	2,639	2.22	Kenya	5,490	1.43
Pakistan	2,280	3.57	Indonesia	2,476	1.53	Cambodia	5,274	1.52
Romania	2,108	3.45	The US	2,334	N/A	Guinea	5,264	1.53
Russia	2,061	4.10	Singapore	2,202	N/A	Colombia	4,451	1.22
Kenya	1,924	4.58	Tanzania	1,920	2.08	Japan	4,393	1.95
Mexico	1,776	3.73	Mexico	1,703	3.97	Indonesia	4,318	1.51
Others	18,280	3.61	Others	8,931	1.82	Others	52,769	1.4
Total	95,793	3.52	Total	85,247	1.61	Total	183,617	1.39

Source: China Customs & CCM

Table 4.3-7 China's exports of glyphosate 51% IPA to major destinations, 2020–2022

2022			2021			2020		
Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg
Australia	2,723	4.99	Australia	12,458	N/A	Australia	39,021	1.38
Singapore	904	4.99	Singapore	1,650	N/A	The United Kingdom	154	1.88
New Zealand	178	4.99	Kazakhstan	166	2.51	New Zealand	81	1.77
The United Kingdom	60	4.99	The US	77	N/A	Ukraine	77	1.97
Kenya	0.02	5.75	Paraguay	66	1.67	Malaysia	14	N/A
Total	3,865	4.99	Total	14,418	0.04	Total	39,346	1.38

Source: China Customs & CCM

Table 4.3-8 China's exports of glyphosate 62% IPA to major destinations, 2020–2022

2022			2021			2020		
Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg
The US	71,204	5.15	The US	71,916	N/A	The US	25,277	0.49
Brazil	6,972	5.06	The Philippines	7,335	2.91	Indonesia	9,349	1.9
The Philippines	5,075	4.44	Indonesia	7,113	2.68	The Philippines	5,819	1.73
Uganda	4,460	5.07	Russia	6,147	3.12	Uganda	3,421	1.82
Kazakhstan	3,834	5.46	Kazakhstan	4,404	2.38	Australia	2,539	1.73
Paraguay	1,956	6.08	Ghana	3,705	0.35	Paraguay	2,484	1.95
Turkey	1,143	6.01	Brazil	3,165	5.12	Canada	2,111	2.37
Chile	864	5.33	Turkey	2,621	3.45	Russia	1,151	1.83
Thailand	693	4.96	Peru	2,512	2.98	Turkey	970	1.61
South Africa	515	5.29	Chile	1,812	3.7	Ukraine	910	1.79
Ghana	376	4.12	Uganda	1,426	3.01	South Korea	839	0.74
Russia	361	6.56	Colombia	1,229	0.67	Ghana	759	N/A
Indonesia	346	5.28	Paraguay	1,050	3.5	Kazakhstan	747	2.39
Bangladesh	325	5.05	Ukraine	1,012	2.93	Israel	545	1.9
Peru	234	4.74	Pakistan	359	2.38	Colombia	519	1.69
Others	1,862	5.32	Others	2,019	2.52	Others	4,186	1.89
Total	100,220	5.15	Total	117,824	1.09	Total	61,625	1.27

Source: China Customs & CCM

Table 4.3-9 China's exports of glyphosate 75.7% WSG to major destinations, 2020–2022

2022			2021			2020		
Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg
Brazil	62,818	9.34	Brazil	59,243	5.99	Brazil	63,483	3.32
Paraguay	3,474	8.31	Paraguay	3,280	4.91	Cote d'Ivoire	3,285	2.95
Uganda	2,531	7.96	Uganda	2,377	5.11	Paraguay	2,699	2.83
Russia	2,246	14.53	Ghana	1,415	1.61	Uganda	2,616	3.31
Ghana	839	9.01	Peru	722	4.81	Cameroon	2,581	3.65
Peru	837	8.33	Kazakhstan	646	5.41	Mexico	900	3.98
Cote d'Ivoire	584	9.18	Russia	624	5.17	Australia	791	2.83
Kazakhstan	524	12.23	Chile	420	5.47	South Africa	719	2.98
South Africa	492	8.57	Singapore	372	N/A	Kazakhstan	660	5.38
Nigeria	384	10.37	The US	257	N/A	Peru	615	3.31
Cameroon	328	9.06	Nigeria	242	3.5	Russia	588	3.15
Chile	149	9.25	South Korea	186	N/A	Uruguay	514	3.01
The US	114	9.34	Ukraine	108	2.86	Chile	505	2.97
Colombia	109	9.15	Mexico	66	7.18	Ghana	420	2.91
New Zealand	102	8.84	Kyrgyzstan	57	3.8	Kenya	357	2.84
Others	739	8.34	Others	183	6.78	Others	3,384	3.01
Total	76,269	9.39	Total	70,196	5.72	Total	84,115	3.29

Source: China Customs & CCM

Table 4.3-10 China's exports of glyphosate technical to major destinations, 2020–2022

2022			2021			2020		
Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg	Destination	Volume, tonne	Price, USD/kg
The US	67,445	10.17	Brazil	86,851	7.09	Brazil	88,225	3.3
Brazil	64,554	9.84	Argentina	63,834	6.92	Argentina	49,261	3.38
Argentina	55,819	11.33	The US	62,793	0.11	The US	44,242	0.89
Russia	20,568	10.31	Australia	18,300	0.04	Australia	23,273	1.41
India	14,549	10.15	Russia	15,203	6.7	Indonesia	21,450	3.38
Paraguay	8,182	10.35	Indonesia	14,235	5.42	India	18,675	2.96
Indonesia	7,445	10.33	India	13,021	4.94	Russia	7,619	3.32
Australia	4,216	10.52	Ireland	12,072	6.19	Ireland	6,898	2.92
Nigeria	4,057	12.70	Paraguay	8,271	6.11	Malaysia	5,515	3.14
Malaysia	2,734	10.61	Malaysia	4,828	6.13	Kazakhstan	3,339	3.24
Guatemala	2,100	10.95	Turkey	2,295	4.08	Nigeria	3,229	2.99
Belgium	1,802	9.24	Ghana	2,270	3.68	Paraguay	2,925	3.29
Turkey	1,790	10.54	Singapore	2,168	N/A	Guatemala	2,868	0.27
Ireland	1,723	11.49	Nigeria	1,999	5.24	Ghana	2,032	2.97
Canada	1,476	11.81	Poland	1,296	5.25	Poland	1,998	3.16
Others	11,309	10.63	Others	12,259	5.67	Others	17,818	2.68
Total	269,767	10.44	Total	321,694	4.87	Total	299,367	2.71

Source: China Customs & CCM

Table 4.3-11 China's exports of glyphosate by month, 2022

Month	41% IPA		51% IPA		62% IPA		75.7% WSG		Tech		Total
	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne
January	6,717	4.03	883	4.99	8,775	5.07	971	9.88	22,400	11.33	39,746
February	8,693	4.46	51	4.99	10,503	5.14	4,004	7.46	32,619	11.27	55,870
March	9,593	3.67	55	4.99	10,647	5.24	3,204	6.45	32,872	11.27	56,371
April	8,510	3.63	67	4.99	9,244	5.55	11,452	11.56	27,352	10.66	56,625
May	15,071	3.57	155	4.99	7,057	6.76	9,688	9.74	36,973	10.16	68,944
June	11,795	3.37	727	4.99	7,116	5.31	16,221	9.74	31,018	10.12	66,877
July	9,271	3.33	131	4.99	6,171	5.07	10,892	9.36	32,069	10.16	58,533
August	7,641	3.19	174	4.99	7,317	5.28	10,157	8.42	23,490	9.82	48,780
September	6,339	3.21	656	4.99	5,726	5.19	5,669	8.75	12,278	10.52	30,669
October	6,746	2.73	290	5.49	13,087	3.83	3,126	7.18	7,306	9.49	30,554
November	4,945	3.22	319	4.54	7,985	5.16	693	15.46	1,614	8.69	15,555
December	472	3.22	358	4.99	6,592	5.15	192	6.57	9,777	7.58	17,390
Total	95,793	3.52	3,865	4.99	100,220	5.15	76,269	9.39	269,767	10.44	545,915

Source: China Customs & CCM

Table 4.3-12 China's exports of glyphosate by month, 2021

Month	41% IPA		51% IPA		62% IPA		75.7% WSG		Tech		Total
	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne
January	7,454	0.98	66	1.67	6,303	1.03	780	2.31	15,700	2.79	30,304
February	4,415	1.02	2,308	0.08	13,837	1.33	1,560	1.99	23,597	2.96	45,717
March	11,807	1.39	83	1.38	11,203	0.85	2,143	3.43	27,908	3.32	53,145
April	14,978	1.14	316	N/A	10,123	0.98	3,833	3.88	24,347	3.07	53,597
May	14,001	1.16	190	N/A	11,154	0.85	7,426	4.02	28,047	3.91	60,818
June	6,371	1.09	1,616	0.02	9,952	0.74	8,796	5.42	28,313	3.80	55,048
July	3,072	2.04	179	0.44	8,718	1.55	7,118	4.92	36,409	5.35	55,496
August	5,711	2.75	6,294	N/A	10,345	0.72	7,268	5.28	30,236	4.74	59,854
September	5,795	2.09	1,890	N/A	4,238	0.56	10,840	5.46	28,742	6.72	51,505
October	3,427	2.35	1,022	N/A	12,580	1.85	5,393	7.19	26,104	6.47	48,526
November	5,793	3.83	137	N/A	6,386	1.45	9,005	8.50	30,675	7.10	51,997
December	2,421	1.74	318	N/A	12,986	0.88	6,032	8.08	21,616	7.01	43,373
Total	85,247	1.61	14,418	0.04	117,824	1.09	70,196	5.72	321,694	4.87	609,379

Source: China Customs & CCM

Table 4.3-13 China's exports of glyphosate by month, 2020

Month	41% IPA		51% IPA		62% IPA		75.7% WSG		Tech		Total
	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne	Price, USD/kg	Volume, tonne
January	30,981	1.50	1,705	1.90	4,986	1.87	4,540	3.36	21,014	3.17	63,226
February	8,988	1.47	2,319	1.67	1,760	1.93	609	3.47	14,477	3.09	28,153
March	46,139	1.45	14,132	1.65	6,762	1.84	5,453	3.14	32,460	3.12	104,946
April	45,424	1.46	14,548	1.64	8,340	1.82	9,958	3.14	31,099	3.11	109,369
May	9,383	1.29	873	N/A	6,937	0.75	5,919	3.42	25,782	2.53	48,894
June	10,649	1.52	560	N/A	5,933	0.71	22,972	3.25	34,137	2.35	74,251
July	7,990	1.36	3,423	N/A	4,932	0.85	8,202	3.29	20,320	2.19	44,867
August	5,247	1.37	203	N/A	4,496	0.76	14,929	3.38	32,650	2.73	57,525
September	5,011	0.86	315	N/A	3,790	0.76	7,987	3.37	19,800	2.59	36,904
October	6,222	1.04	969	N/A	3,533	1.51	2,414	3.53	17,351	2.43	30,488
November	4,752	0.99	164	N/A	3,517	1.64	814	3.03	27,593	2.53	36,840
December	2,832	0.48	136	N/A	6,639	1.02	319	2.74	22,685	2.63	32,610
Total	183,617	1.39	39,346	1.38	61,625	1.27	84,115	3.29	299,367	2.71	668,070

Source: China Customs & CCM

4.4 Chinese glyphosate flow

China is the largest glyphosate supplier in the world. In 2020–2022, the main exporters of glyphosate formulation in China include Xingfa (Shanghai) International Trade Co., Ltd., Shandong Weifang Rainbow Chemical Co., Ltd., Zhejiang Wynca Chemical Industrial Group Co., Ltd., etc. Key export destinations of China's glyphosate formulation include Brazil, Nigeria and the US.

In 2020–2022, the main exporters of glyphosate technical in China include Fuhua Tongda Chemical Co., Ltd., Nantong Jiangshan Agrochemical & Chemicals Co., Ltd., Youth Chemical Co., Ltd., etc. Key export destinations of China's glyphosate technical include Brazil, Argentina and the US. In 2022, a total of 187,818 tonnes of China's glyphosate technical was exported to the three countries, accounting for 69.6% of China's total export volume.

Table 4.4-1 Exporters of glyphosate formulation in China, 2020–2022

2022		2021		2020	
Exporter	Volume, tonne	Exporter	Volume, tonne	Exporter	Volume, tonne
Shandong Weifang Rainbow Chemical Co., Ltd.	22,464	Xingfa (Shanghai) International Trade Co., Ltd.	16,556	Shandong Weifang Rainbow Chemical Co., Ltd.	80,508
Xingfa (Shanghai) International Trade Co., Ltd.	19,695	Shandong Weifang Rainbow Chemical Co., Ltd.	16,088	Zhejiang Wynca Chemical Industrial Group Co., Ltd.	28,103
Zhejiang Wynca Chemical Industrial Group Co., Ltd.	10,528	Zhejiang Wynca Chemical Industrial Group Co., Ltd.	15,697	Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	21,315
Shandong Rainbow Agrosiences Co., Ltd.	7,996	Shanghai Good Farm International Trading Co., Ltd.	10,101	Fuhua Tongda Chemical Co., Ltd.	20,452
Sinochem Agro Co., Ltd.	7,386	Fuhua Tongda Chemical Co., Ltd.	9,371	Xingfa (Shanghai) International Trade Co., Ltd.	17,779
Fuhua Tongda Chemical Co., Ltd.	6,994	Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	7,658	Hubei Trisun Chemical Co., Ltd.	11,767
Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	6,365	Zhejiang Jinfanda Biochemical Co., Ltd.	6,961	Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.	7,830
Anhui Zhongshan Chemical Co., Ltd.	6,334	Afri Ventures FZE	6,934	Zhejiang Jinfanda Bio-Chemical Co., Ltd.	7,380
Zhejiang Wynca Import and Export Co., Ltd.	5,865	Hubei Xingfa Chemicals Group Co., Ltd.	6,151	Sinochem Agro Co., Ltd.	7,070
Guangxin Tongda Shanghai Imp. and Exp. Co., Ltd.	5,743	Shanghai Hui Song (H&S) Agro-Solution Co., Ltd.	5,904	Shanghai Hui Song (H&S) Agro-Solution Co., Ltd.	6,054
Blu Logistics	5,661	Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.	5,436	Ningbo Generic Chemical Co., Ltd.	5,547
Afri Ventures FZE	5,512	Excel Chemical Co., Ltd.	3,920	Anhui Huaxing Chemical Co., Ltd.	5,235
Shanghai Hui Song (H&S) Agro-Solution Co., Ltd.	5,494	Shenzhen Baocheng Chemical Industry Co., Ltd.	3,764	Shanghai Lianrui Chemical Co., Ltd.	5,151
FH Agrochemical International Trade Pte Ltd.	5,228	Nufarm Chemical (Shanghai) Co., Ltd.	3,732	Shenzhen Baocheng Chemical Industry Co., Ltd.	5,100
Hubei Xingfa Chemicals Group Co., Ltd.	5,065	Hubei Trisun Chemical Co., Ltd.	3,614	Sh-Inform Chemical Co., Ltd.	4,098
Others	149,818	Others	165,798	Others	135,314
Total	276,147	Total	287,685	Total	368,703

Source: China Customs & CCM

Table 4.4-2 Exporters of glyphosate technical in China, 2020–2022

2022		2021		2020	
Exporter	Volume, tonne	Exporter	Volume, tonne	Exporter	Volume,tonne
Fuhua Tongda Chemical Co., Ltd.	42,748	Fuhua Tongda Chemical Co., Ltd.	37,872	Fuhua Tongda Chemical Co., Ltd.	63,774
Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.	30,127	Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.	23,345	Youth Chemical Co., Ltd.	29,614
Youth Chemical Co., Ltd.	21,233	Youth Chemical Co., Ltd.	23,251	Hubei Trisun Chemical Co., Ltd.	26,197
Nufarm Chemical (Shanghai) Co., Ltd.	18,961	Nufarm Chemical (Shanghai) Co., Ltd.	16,947	Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.	22,678
Zhejiang Wynca Chemical Industrial Group Co., Ltd.	17,318	Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	13,335	Zhejiang Wynca Chemical Industrial Group Co., Ltd.	16,605
Xingfa (Shanghai) International Trade Co., Ltd.	9,459	Zhejiang Wynca Chemical Industrial Group Co., Ltd.	10,330	Shandong Weifang Rainbow Chemical Co., Ltd.	11,806
Sinochem Agro Co., Ltd.	6,197	Sinochem Agro Co., Ltd.	8,694	Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	11,786
Anhui Guangxin Agrochemical Co., Ltd.	5,770	Hubei Trisun Chemical Co., Ltd.	7,503	Sinochem Agro Co., Ltd.	10,605
Zhenjiang Jiangnan Chemical Co., Ltd.	5,744	Hebei Bestar Commerce and Trade Co., Ltd.	5,994	Xiamen C&D Chemical Co., Ltd.	10,538
Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.	5,277	Zhenjiang Jiangnan Chemical Co., Ltd.	5,417	Sichuan Hebang Biotechnology Co., Ltd.	9,924
FH Agrochemical International Trade Pte Ltd.	4,953	Ningbo Tide Import and Export Co., Ltd.	5,347	Ningbo Tide Import and Export Co., Ltd.	7,503
Hubei Trisun Chemical Co., Ltd.	4,470	FH Agrochemical International Trade Pte Ltd.	4,914	Zhenjiang Jiangnan Chemical Co., Ltd.	7,381
Hebei Bestar Commerce and Trade Co., Ltd.	3,312	Syngenta (Suzhou) Crop Protection Co., Ltd.	4,256	Hebei Bestar Commerce and Trade Co., Ltd.	4,360
Shandong Weifang Rainbow Chemical Co., Ltd.	3,288	Xingfa (Shanghai) International Trade Co., Ltd.	4,154	Yichang Three Gorges bonded supply chain Co., Ltd.	3,952
Sinochem International Crop Care Company Limited	3,188	Sichuan Hebang Biotechnology Co., Ltd.	4,108	Shanghai Agrohao International Trade Co., Ltd.	3,615
Others	87,723	Others	146,228	Others	59,028
Total	269,767	Total	321,694	Total	299,367

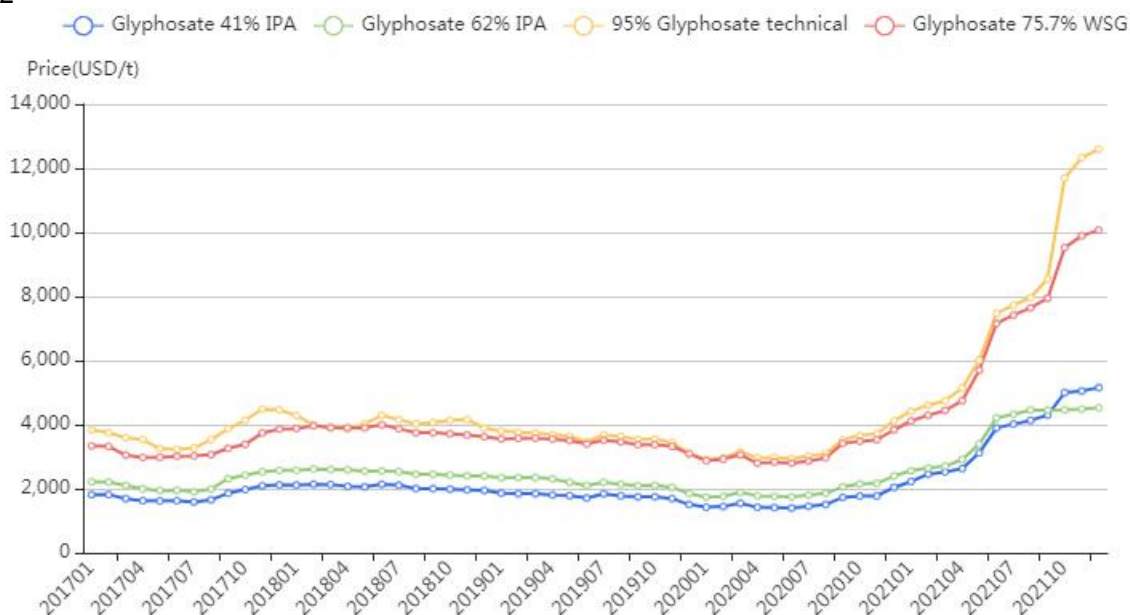
Source: China Customs & CCM

5 Price

5.1 Price changes in the past and key factors

The prices of glyphosate technical and formulations are highly correlated. When the price of glyphosate technical rises, so does the price of glyphosate formulations. Therefore, the factors influencing glyphosate technical price are introduced in detail here.

Figure 5.1-1 Monthly ex-works price of glyphosate technical and key formulations in China, Jan. 2018~Dec. 2022



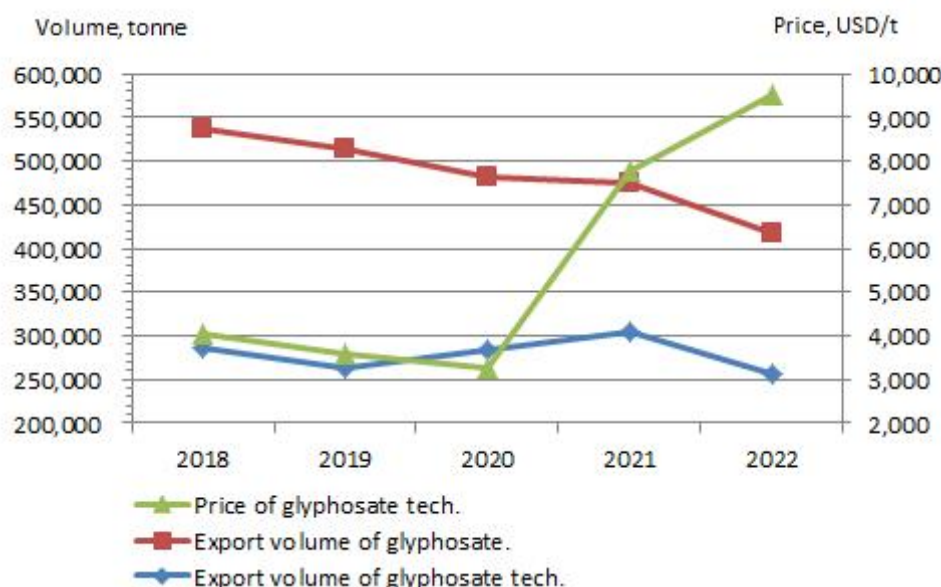
Source:CCM

- Supply and demand

Since around 80% of the glyphosate products made in China are exported annually, the demand for glyphosate technical overseas influences the ex-works price in China.

Though China plays an important role in the global glyphosate market (the capacity of glyphosate technical in China was about 830,000 t/a, and that beyond China was less than 400,000 t/a as of 2022), its bargaining power is relatively weak because China's glyphosate formulations are less competitive in overseas market.

Figure 5.1-2 Annual average ex-works price of glyphosate technical and annual export volume of glyphosate in China, 2018–2022



Note:1. Export volume of glyphosate covers both technical and formulations. 2. All the export data here are calculated by 100% AI volume.

Source: China Customs & CCM

In 2018, since overseas demand was stable, the price of glyphosate kept stable with small fluctuations.

In 2019, the price saw a slight drop for the falling overseas demand.

In 2020, the price decreased by 9.22% year on year, as the glyphosate market was affected negatively by the COVID-19 pandemic.

In 2021, with the strong demand, tight supply and increasing prices of raw materials, its price increased by 138.81% year on year.

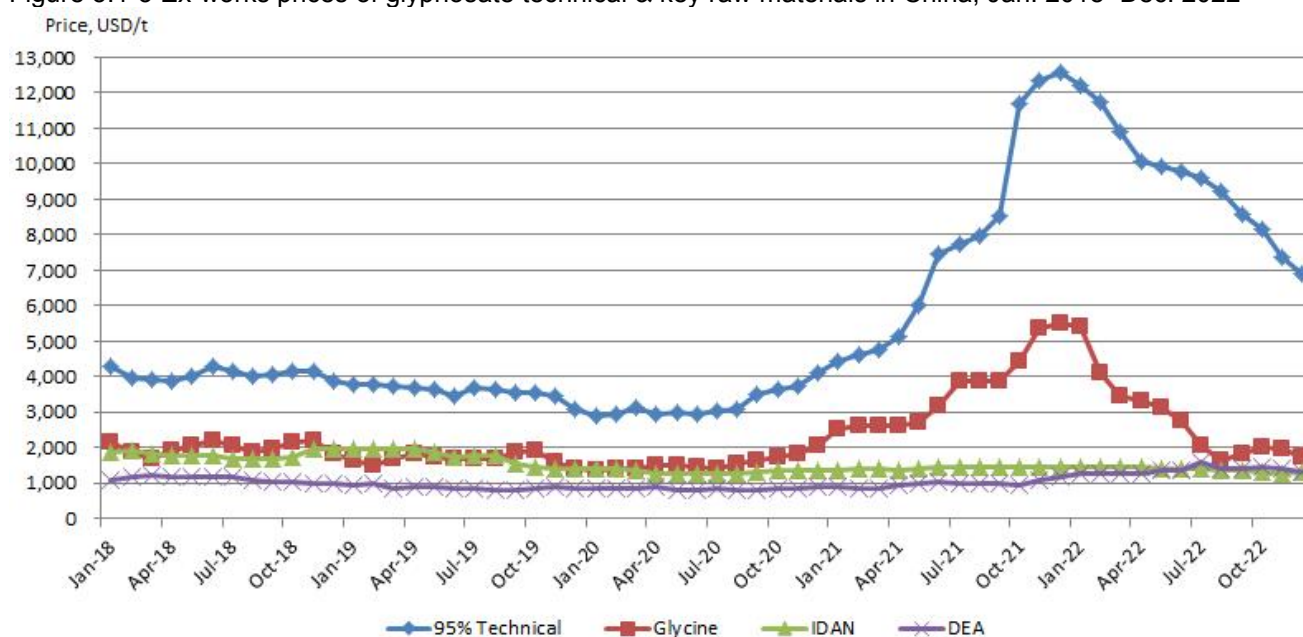
In 2022, although the average ex-works price of glyphosate technical increased by 22.8% from 2021, it decreased by 43.5% from USD12,226.86/t at the beginning of the year to USD6,914.71/t at the end of the year, which was mainly caused by the decrease in raw material prices and market demand.

- Production cost

The production cost is one of the key factors determining the price of glyphosate technical. In general, there is a positive correlation between the price of glyphosate technical and the price of its raw materials. However, the influence of production cost is gradually receding along with technological advances such as increased output and the establishment of integrated chains.

In recent years, the production cost has been falling. Moreover, through the adjustment of product mix, some key Chinese producers have lowered their dependence on glyphosate technical. In other words, these players can operate normally even when the price and profit margin of the product are low.

Figure 5.1-3 Ex-works prices of glyphosate technical & key raw materials in China, Jan. 2018–Dec. 2022



Note: Price of DEA is the monthly average of imported DEA, because Chinese producers mainly take imported DEA to produce glyphosate technical.

Source: CCM

- Governmental policy

Government policies, such as environmental protection standards and tax policies, have an impact on the supply, manufacturing costs and the price of glyphosate technical. In addition, as the price of natural gas affects the cost of IDAN, it will also influence the prices of PMIDA and glyphosate technical.

In Aug. 2021, the National Development and Reform Commission issued the *Barometer of Achievement of Dual Energy Control Targets by Regions in H1 2021*. ("Dual control" to reduce energy intensity and to limit total energy consumption is a key measure that the Chinese government implements to help meet the energy and climate goals.) Glyphosate capacities in 12 provinces, including Zhejiang, Jiangsu, Anhui and Ningxia, were severely restrained in October due to the energy control measures, insufficient power supply

and strict environmental protection regulations. Limited power and production caused supply constraints and the ex-works price of glyphosate technical rose rapidly as a result.

On 18 July, 2022, the Development and Reform Commission of Henan Province released the *"Banned, Restricted, and Controlled" Catalogue for Chemical Industrial Transfers to Henan Province*, which involved 17 categories of process equipment (glyphosate production equipment included) and 8 categories of chemicals (10% glyphosate AS included).

In Nov. and Dec. 2022, in order to implement the policy of safety, environmental protection and national energy consumption control, major glyphosate manufacturers in China actively reduced glyphosate production by rotating production equipment maintenance and other means, while ensuring supply. The monthly production limit was about one-third of the total output, reducing the monthly output of glyphosate by about 20,000 tonnes.

5.2 Price forecast, 2023–2027

- Price forecast

During 2013–2022, the annual growth rates of ex-works prices for glyphosate technical averaged about 14.6%; they vary considerably from year to year, which are less helpful for trend forecasting.

Entering 2023, its ex-works price continued to decline, falling to USD4,905.17/t in April.

At present, there is a trend of oversupply in the market, and the profit margin of glyphosate technical is relatively high, leaving room for further price reduction. In the later stage, the price may return rationally and remain stable.

Table 5.2-1 Yearly growth rates of glyphosate's annual average ex-works price and export volume in China, 2013–2022

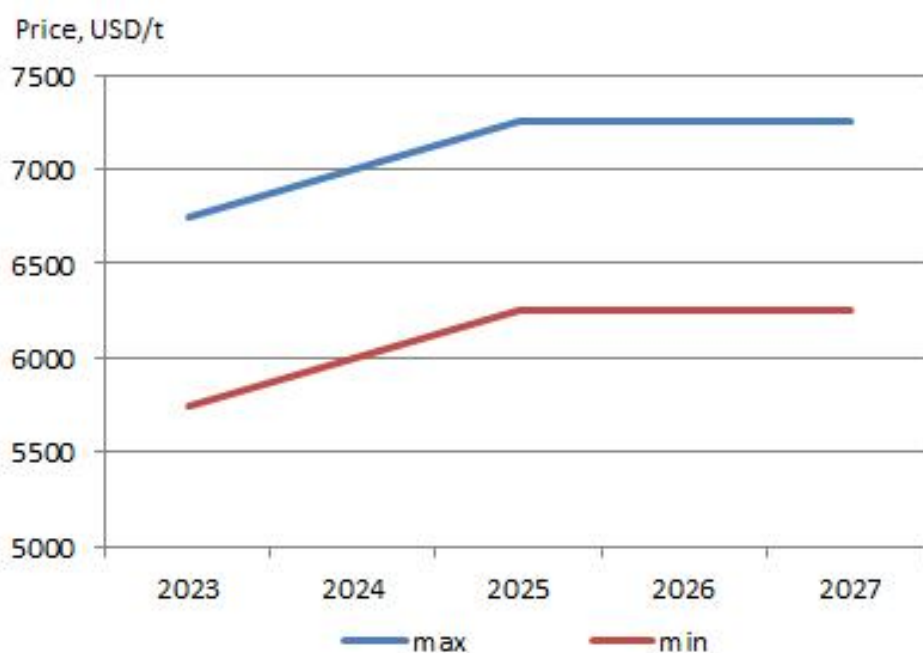
Item	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Annual average ex-works price	30.1%	-18.7%	-32.9%	-11.9%	30.5%	8.5%	-11.9%	-9.2%	138.8%	22.8%
Export volume (tech.)	22.0%	-4.7%	-6.1%	16.8%	-6.5%	2.6%	-8.3%	7.4%	10.2%	-17.3%
Export volume (all)	20.3%	3.6%	-7.6%	16.8%	-0.6%	0.1%	-4.6%	-4.1%	1.2%	-13.1%

Source:CCM

The four-year forecast on glyphosate technical price is made under the conditions below:

- Supply & demand beyond China (export volume and demand from GM crops' planting) is the key factor for the future prospect;
- China's supply will be stable and will not decrease a lot since many medium- and small-sized manufacturers have stopped production completely and the industrial concentration rate goes up year by year;
- The global demand for glyphosate will keep increasing but the growth rate will decline because the adoption of GM crops in key planting countries tends to be saturated;
- Suppose that there is no suitable substitute for glyphosate;
- Suppose that the economic development in China and in the world keep stable;
- Suppose that there is no publication of new policies with eventful effects on glyphosate in China and in the world;
- Suppose that key Chinese players don't go bankrupt;
- Suppose that planting areas of GM crops stop declining (the planting areas decreased for the first time in 2015) but increase (about ten years are needed for the commercialisation of a new GM seed);
- Suppose that the annual growth rate of the USD/CNY exchange rate is within $\pm 3\%$.

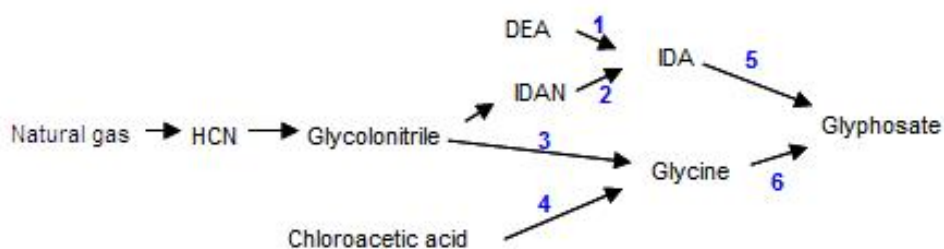
Figure 5.2-1 Forecast on glyphosate technical price in China, 2023–2027



Source:CCM

6 Production technology & technology level

Figure 6-1 Production pathways of glyphosate technical in China



Note:

1) DEA route

2) IDAN route

3) HCN route (No enterprise in China adopted this route since 2010)

4) Glycine route

5) IDA pathway

6) AEA pathway

Source:CCM

Currently, there are two production pathways of glyphosate technical in China, namely the aminoethanoic acid (AEA) pathway (also named the glycine route) and the iminodiacetic acid (IDA) pathway. The latter includes two routes: the diethanolamine (DEA) route and the iminodiacetonitrile (IDAN) route.

The IDA pathway is popular in Western countries, while most glyphosate producers in China adopt the AEA pathway due to its mature technology, low cost, sufficient supply of raw materials, complete industrial chain, etc.

During the last few years, the Chinese government has taken a series of measures to strengthen environmental protection, such as the ban on glyphosate SL with content less than 30% and the launch of environmental protection verification (EPV) by the Ministry of Environmental Protection of China in 2013. The stricter environmental protection policies have driven up the cost of glyphosate mother liquor disposal dramatically. As the impurity of mother liquor waste generated from the AEA pathway is the most difficult to be disposed of among the three routes, the treatment cost for the AEA pathway is also the highest. However, the cost of the AEA pathway has an advantage over the IDAN route and the DEA route if by-product recovery is included.

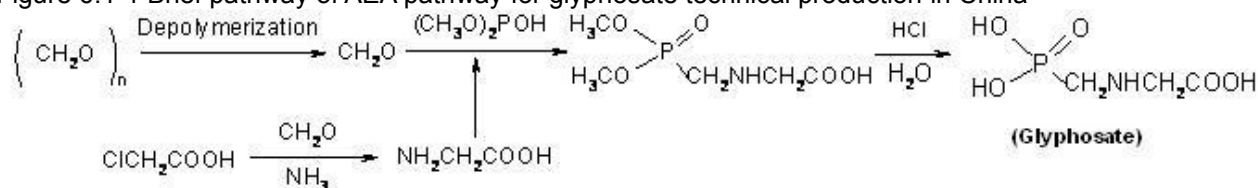
6.1 Introduction of AEA pathway

The aminoacetic acid (AEA) pathway, with chloroacetic acid as the starting raw material and glycine as the main raw material, was developed by the Shenyang Research Institute of Chemical Industry in the 1980s.

In China, the AEA pathway is widely used, as the technique of this pathway is quite simple for most glyphosate producers to master. While most overseas countries in Europe and South America prefer to choose the iminodiacetic acid (IDA) pathway due to less environmental pollution caused and better product quality through this way. Most international glyphosate traders have registration of IDA-pathway glyphosate only.

The AEA pathway involves three major procedures: preparation of glycine, preparation of glyphosate and hydrolysis process. Raw materials needed include glycine, paraformaldehyde, triethylamine, methanol, yellow phosphorus or dimethyl phosphite (DMP), hydrochloric acid and sodium hydroxide. Some producers use yellow phosphorus to produce DMP by themselves, while most just purchase DMP.

Figure 6.1-1 Brief pathway of AEA pathway for glyphosate technical production in China



Source:CCM

The unit cost of the AEA pathway for the production of glyphosate technical in 2022 was 80.7% higher than in 2021, mainly due to the significant increase in the price of dimethyl phosphite; in addition, exchange rate growth was also a contributing factor.

Methyl chloride, a by-product of the AEA pathway for glyphosate technical production, can be recycled and reused for producing other products, thus reducing the unit cost of glyphosate technical production to some extent.

Table 6.1-1 Raw material cost of AEA pathway for glyphosate technical production in China, March 2023

Item	Unit consumption, t/t	Price, USD/t	Unit cost, USD/t
Glycine (industrial grade)	0.57	1,873	1,068
Dimethyl phosphite (DMP)	1.02	3,862	3,939
Paraformaldehyde (96%)	0.45	764	344
Triethylamine (99.5%)	0.03	2,161	65
Methanol (95%)	0.32	389	124
Hydrochloric acid (31%)	2.14	26	56
Methyl chloride (99%)	-0.55	375	-206
Total	/	/	5,389

Note: The unit price is not only based on the ordinary market price but also the degree of economic scale, operating rate and backward integration of glyphosate manufacturers.

Source: CCM

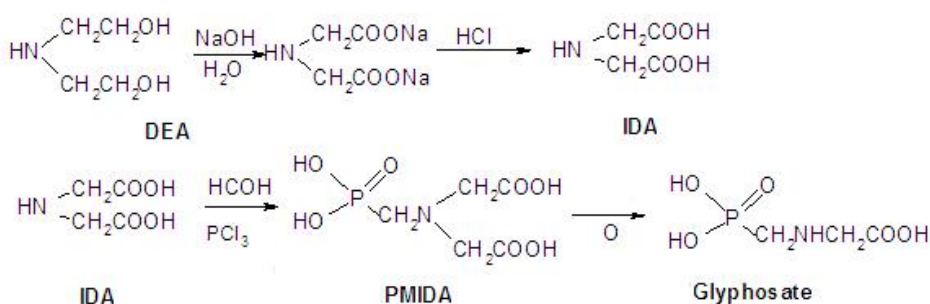
6.2 Introduction of DEA route

In the 1990s, the competition in the international glyphosate industry was very intense and the price of glyphosate kept dropping, with the lowest price of glyphosate falling to USD2,900/t. Many domestic glyphosate producers adopting the AEA pathway could not maintain their normal production. Therefore, some research institutes and producers turned their attention to the research and development of the IDA pathway. As they did not have the technology to produce IDAN from HCN, in 1997, Chinese producers independently developed another way to produce IDA and glyphosate, namely the DEA route, although this route had already been developed by Monsanto and Syngenta years before.

The quality of glyphosate made by the DEA route is quite good. It is reported that it's relatively easy to register the glyphosate technical made by this route in overseas countries. However, as the production cost of the DEA route has no competitive advantage compared with the AEA pathway and IDAN route, the number of production lines adopting the DEA route has shown a decreasing trend during the past few years.

The DEA route has three major procedures, namely dehydrogenation, condensation reaction and oxidation process.

Figure 6.2-1 Brief pathway of DEA route for glyphosate technical production in China



Source: CCM

Table 6.2-1 Raw material cost of DEA route for glyphosate technical production in China, March 2023

Item	Unit consumption, t/t	Price, USD/t	Unit cost, USD/t
DEA (99%)	0.90	1,376	1,238
Phosphorous acid (99%)	0.88	1,729	1,522
Formaldehyde (37%)	0.89	184	164
Sodium hydroxide (99%)	0.77	533	411
Hydrochloric acid (31%)	2.58	26	67
Raney Cu	0.02	27,378	548
Activated carbon catalyst	0.01	1,297	13
Total	/	/	3,692

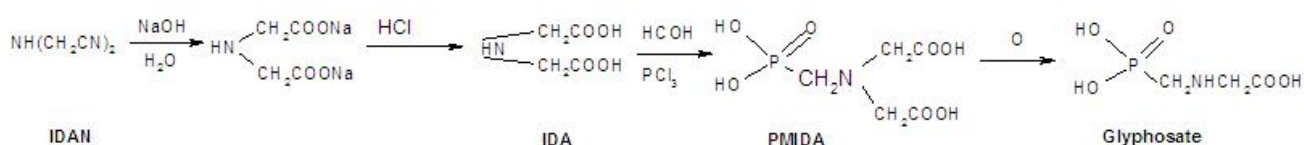
Note: The unit price is not only based on the ordinary market price but also the degree of economic scale, operating rate and backward integration of glyphosate manufacturers.

Source: CCM

6.3 Introduction of IDAN route

After several years of development, IDAN supply can satisfy the current glyphosate production in China. Compared with the DEA route, the IDAN route has an advantage in production cost, and this will continue in a long term. As IDA is used both in the DEA route and the IDAN route, many Chinese producers adopting the IDA pathway have DEA production lines as well as IDAN production lines; therefore, they can switch between the raw materials DEA and IDAN, depending on their supply and price. The detailed IDAN route involves three major procedures, namely hydrolysis reaction, condensation reaction and oxidation process.

Figure 6.3-1 Brief pathway of IDAN route for glyphosate technical production in China



Source: CCM

Table 6.3-1 Raw material cost of IDAN route for glyphosate technical production in China, March 2023

Item	Unit consumption, t/t	Price, USD/t	Unit cost, USD/t
IDAN (92%)	0.80	1,340	1,072
Phosphorus trichloride (99%)	1.33	1,059	1,409
Sodium hydroxide (99%)	0.82	533	437
Hydrochloric acid (31%)	2.75	26	72
Formaldehyde (37%)	0.78	184	144
Activated carbon catalyst	0.01	1,297	13
Total	/	/	3,146

Note: The unit price is not only based on the ordinary market price but also the degree of economic scale, operating rate and backward integration of glyphosate manufacturers.

Source: CCM

6.4 Comparison of different pathways and development trend

The three production routes will still coexist in China in the future, and the competitiveness of the three routes is determined by technology maturity level, production cost and raw material accessibility, etc.

It is estimated that the AEA pathway will remain competitive and maintain its dominant position in China in the coming few years because of mature technology, abundant supply of raw materials, complete industrial layout, and huge market of by-products.

The IDAN route also will keep competitive in China because the supply of raw materials (mainly IDAN and PMID) is sufficient and more producers tend to directly purchase PMID to produce glyphosate and the overall production cost of the IDAN route is still relatively low.

The DEA route will be less advantageous in the future competition, because there is only one company adopting DEA route in China, who has no expansion plan.

Table 6.4-1 Comparison of the three production routes of glyphosate technical in China

Item	AEA route	DEA route	IDAN route
Strong point	Mature technology, low investment (waste treatment and by-product recovery excluded), easily available raw materials	High yield, good product quality, good safety control during production, and mature technology	High yield, good product quality, available raw materials and low production cost
Shortcoming	Long production process, high impurity content, and much wastes (high investment on waste treatment), low yield	High dependence on imported DEA (caused by high price of homemade DEA), high requirement on equipment and thus high investment	High technology barrier, high requirement on equipment and thus high investment; raw material cost may rise sharply if the domestic price of nature gas catches up with the international level
Raw material supply	Sufficient	Depending on imported DEA	Sufficient, especially PMID
Wastewater	There are nearly saturated inorganic salt, OP compounds of high concentration and glyphosate isomer in the wastewater, which is with biological toxicity.	PMIDA wastewater from condensation process: There are OP compounds of high concentration in the wastewater, which is with biological toxicity; 3% of formaldehyde contained in wastewater becomes a biological inhibitor; the intermediate, DEA or IDAN, and its derivative are refractory; it contains 18%–22% of NaCl which is nearly saturated saline solution. PMID oxidation: There are OP compounds of high concentration in the wastewater, which is with biological toxicity; the wastewater contains 3% of formaldehyde, 2.5% of glyphosate products, unspent PMID and other by-products.	
Product quality	Content is about 95%	Content can reach 97%	Content can reach 97%
Major recyclable by-products	Chloromethane, methylal, sodium chloride, phosphorous acid, hydrochloric acid, sulphuric acid, sodium pyrophosphate, etc.	Urotropine, sodium chloride, ammonium sulphate, etc.	Urotropine, sodium chloride, ammonium sulphate, etc.
Initial application time in China	1986	1995	2005
Cost	Highest (mainly due to high raw materials prices)	Lowest	Middle
Typical company	Zhejiang Wynca, Hubei Trisun and Fuhua Tongda	Jiangsu Yangnong	Nantong Jiangshan, Leshan Hebang
Development trend	Will keep the dominant role in China in the future	Will remain relatively stable	Will keep competitive

Note: The cost mainly includes that of raw materials, utilities, labor, packing, maintenance and depreciation.

Source:CCM

7 Demand for glyphosate

7.1 Overview of China's glyphosate consumption

Only a small share of glyphosate is consumed domestically every year, ranging from 16%–21% of the output in 2018–2022.

7.2 Position and market size of glyphosate in herbicide industry

Table 7.2-1 Output and consumption of glyphosate and share in herbicides in China, 2013–2022, tonne

Year	Output			Consumption		
	Herbicide	Glyphosate	Share	Herbicide	Glyphosate	Share
2013	1,799,823	512,000	28.4%	209,000	65,500	31.3%
2014	1,803,049	534,000	29.6%	215,000	70,000	32.6%
2015	1,771,918	520,000	29.3%	220,000	76,000	34.5%
2016	1,772,982	600,000	33.8%	222,000	86,000	38.7%
2017	1,016,000	600,000	59.1%	209,000	95,000	45.5%
2018	931,000	605,000	65.0%	208,000	100,000	48.1%
2019	935,000	590,000	63.1%	208,000	106,000	51.0%
2020	1,004,000	595,000	59.3%	207,000	115,000	55.6%
2021	1,050,000	604,000	57.5%	212,000	122,000	57.5%
2022	N/A	595,000	N/A	216,000	124,000	57.4%

Note: The consumption volume is converted to the most frequently used technical of each herbicide.

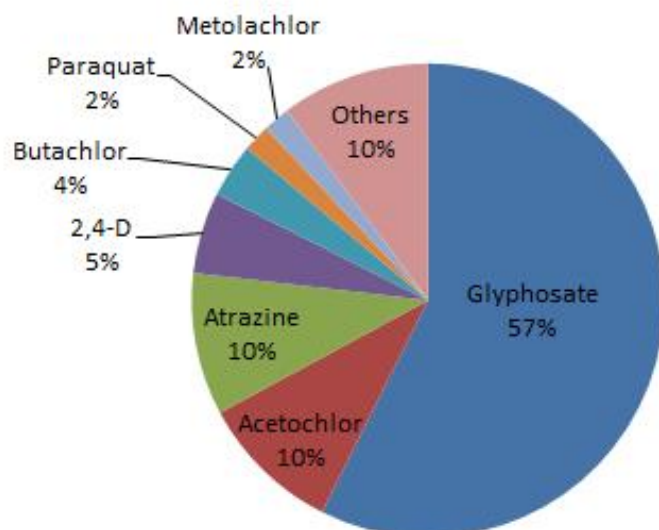
Source: National Bureau of Statistics & CCM

As a non-selective herbicide, after so many years' promotion, glyphosate has taken an irreplaceable position in the weeding for orchard, wasteland reclamation and traditional crop fields in pre-seeding period.

Its consumption grew at a CAGR of 7.4% in 2013–2022, higher than that of the total herbicide consumption (about 0.4%) during the same period, reaching about 124,000 tonnes (calculated by 95% technical) in 2022, accounting for 57.4% of the total herbicide consumption in China (converted to the most frequently used technical of each herbicide).

In 2022, the most popular herbicides in China with annual consumption volume exceeding 5,000 tonnes each (calculated by 100% technical) included glyphosate, acetochlor, atrazine, 2,4-D, and butachlor; among which, those with annual consumption volume of above 10,000 tonnes each were glyphosate, acetochlor, atrazine and 2,4-D.

Figure 7.2-1 Consumption structure of main herbicides in China, 2022



Note: Converted to and calculated by the most frequently used technical of each herbicide.
Source: CCM

7.3 Glyphosate application in China

7.3.1 By specific formulation

The domestic consumption of glyphosate has been increasing in the past few years, and glyphosate 30% SL (41% IPA mainly) is the most popular formulation consumed in the domestic market, whose consumption volume accounted for over 90% of total consumption volume of glyphosate (converted to and calculated by glyphosate technical) in 2018–2022.

Table 7.3.1-1 Consumption of glyphosate formulations in China, 2018–2022

Year	Consumption volume, tonne			Market share (converted to glyphosate technical)		
	30% SL	62% IPA	Others	30% SL	62% IPA	Others
2018	295,000	3,400	7,200	93.8%	1.6%	4.6%
2019	315,000	3,600	7,300	94.0%	1.6%	4.4%
2020	340,000	3,600	7,700	94.2%	1.5%	4.3%
2021	360,000	3,700	8,100	94.4%	1.5%	4.2%
2022	365,000	3,700	8,500	94.2%	1.5%	4.3%

Note: 30% SL include glyphosate 41% IPA and 33% glyphosate ammonium.
Source: CCM

7.3.2 By crop

From 2018 to 2022, there was little change in the crop planting area in China. The main crops include corn, rice, wheat, beans and cotton, with the total planting area accounting for about 65.9% of the total in 2022.

Table 7.3.2-1 Planting area of main crops in China, 2018–2022, '000 hectare

Crop	2018	2019	2020	2021	2022
Orchard	11,875	12,277	12,646	12,962	13,547
Vegetables	20,439	20,863	21,485	21,744	22,375
Corn	42,130	41,284	41,264	43,320	43,070
Rice	30,189	29,694	30,076	29,920	29,450
Wheat	24,266	23,728	23,380	23,570	23,519
Rubber	1,260	1,270	1,270	1,270	1,270
Tea	2,986	3,105	3,217	3,264	3,200
Beans	10,186	11,075	11,593	10,121	10,243
Cotton	3,354	3,339	3,169	3,030	3,000
Sugarcane	1,406	1,391	1,353	1,326	1,300
Sub-total	148,092	148,025	149,454	150,527	150,974
National total	165,902	165,931	167,487	165,931	165,937
Share in total	89.30%	89.20%	89.20%	90.72%	90.98%

Source: National Bureau of Statistics of China

In China, glyphosate is widely used to weed for orchard, wasteland reclamation and traditional crops before seeding for its broad weed spectrum and high efficiency. Mainly applied in upland crops, glyphosate sees small application in rice fields.

In recent years, the commercialisation of GM crops in China has been gradually liberalised and it is expected that with the increase in the area of GM crops planted in China in the future, glyphosate will also usher in a new opportunity for development.

- Orchard

Orchards covered an area of about 13.5 million hectares in China in 2022, and the main fruits are orange, apple, pear, peach, grape, litchi, banana, etc.

As the largest application field of glyphosate in China, orchard takes up about 35% of the domestic consumption of glyphosate in 2022.

As to the weeding for orchards, glyphosate is mainly used in the planting areas of orange, apple and litchi in China. The three types of orchards consumed about 33,142 tonnes of glyphosate (calculated by 95% technical) in 2022, accounting for over 75% of the total consumption of glyphosate in orchards and about 27% of the total consumption of glyphosate in China.

Glyphosate is suitable to remove weeds for deep-rooted fruit trees, such as orange, apple and litchi, but not for shallow-rooted trees, such as peach, pear and grape, so a higher share of the orchards including orange,

apple and litchi use glyphosate to weed compared with that of pear and grape. In orchards of shallow-rooted fruits, paraquat is widely used by farmers in China.

Figure 7.3.2-1 Geographical distribution of main orchards in China, 2022



Source:CCM

Table 7.3.2-2 Consumption of glyphosate (calculated by 95% technical) in main fruits in China, 2018–2022, tonne

Fruit	2018	2019	2020	2021	2022
Orange	14,267	15,677	17,479	18,842	19,361
Apple	6,295	7,344	8,732	9,761	10,474
Litchi	2,593	2,800	3,098	3,175	3,308
Grape	1,070	1,145	1,229	1,314	1,403
Others	7,400	7,845	8,315	8,720	9,250
Total	31,625	34,811	38,853	41,812	43,795

Source:CCM

Orange and litchi are mainly distributed in two regions with abundant rainfall, namely South China and Central China, where weed damage is serious and orchards must be weeded frequently.

Apple is mainly distributed in dry areas, including the north and the northwest of China, where the rainy season stretches from July to August and two weedings each year are enough: weed germination stage in early spring and rapid growth period in July. In some apple orchards, however, farmers do not have a set time for weed control. Instead, they spray glyphosate whenever there are weeds. As a result, they have to weed three to four times a year. In fact, the best time to weed apple orchards is when the weeds reach 15 cm in height, usually in June or July in northern China. If weeding is done too early, glyphosate will only kill the tender leaves of perennial weeds, but not the roots; if too late, the flowering period has passed and

weeds have little vitality, then glyphosate will not easily reach the roots of the weeds.

Despite its high efficiency, the long-term and frequent use of glyphosate is likely to cause damage to fruit trees. Besides, glyphosate can completely kill the roots of weeds to prevent their growth, but orchards need some weeds to hold the moisture of the soil for fruit growth, and the dead weed in the soil helps maintain soil fertility. Moreover, the long-term application of glyphosate can lead to zinc deficiency in the soil and influence the growth of fruits.

Now some researchers suggest using the machine to cut down shrubs and weeds. Though most farmers still use herbicides for weed control, they begin to control the application times of glyphosate in China. For example, some farmers in Shandong Province use glyphosate in orchards once every three years. However, with the ban on paraquat AS formulations in China, the consumption of glyphosate has kept increasing stably.

- Traditional crops (mainly including corn, rice, wheat, beans and cotton)

As a non-selective herbicide, glyphosate can kill weeds and crops when it is directly sprayed onto the leaves of crops. As to weeding for traditional crops, including rice, wheat, corn, beans and cotton, glyphosate is mainly used before seeding or after harvest of crops. Farmers generally choose selective herbicides to control the weeds in the post-emergence of crops, so selective herbicides have wider application in traditional crops compared with non-selective ones. For example, acetochlor is the most widely used selective herbicide in the upland crops and butachlor is most popular in the weeding for rice.

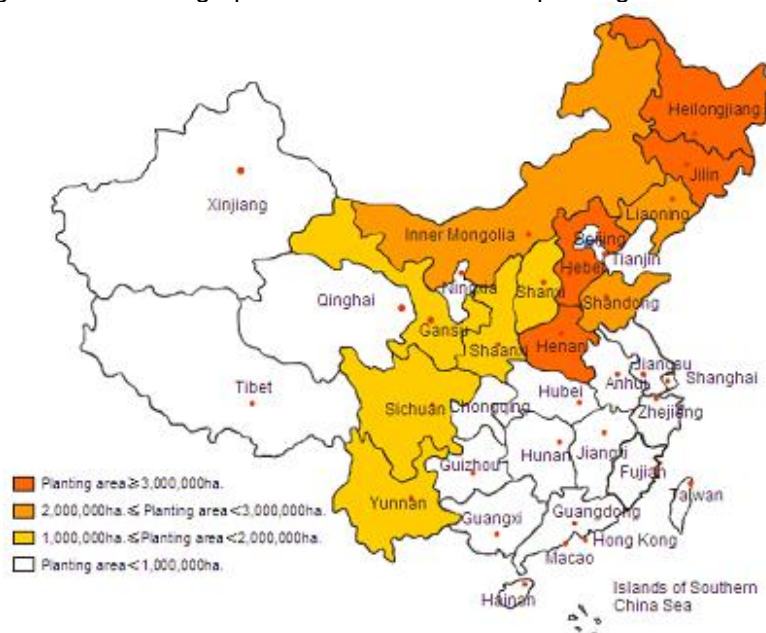
Corn

Corn planting is mainly concentrated in Northeast China and in the provinces of Shandong, Hebei and Henan.

The consumption of glyphosate in corn fields was about 10,198 tonnes (calculated by 95% technical) in 2022, taking up 8% of the total consumption in China.

Glyphosate is only used in the pre-seeding stage of corn as it is a shallow-rooted crop. In the pre-emergent stage of corn, acetochlor and atrazine are commonly used in corn fields. Before the period of crop with 5–6 leaves, farmers choose selective herbicides, mainly nicosulfuron, to weed for corn. And many farmers in the northeast of China, especially in Heilongjiang Province, mostly use nicosulfuron or nicosulfuron mixed with atrazine rather than non-selective herbicides to weed in the whole post-emergent state.

Figure 7.3.2-2 Geographical distribution of corn planting area in China, 2022

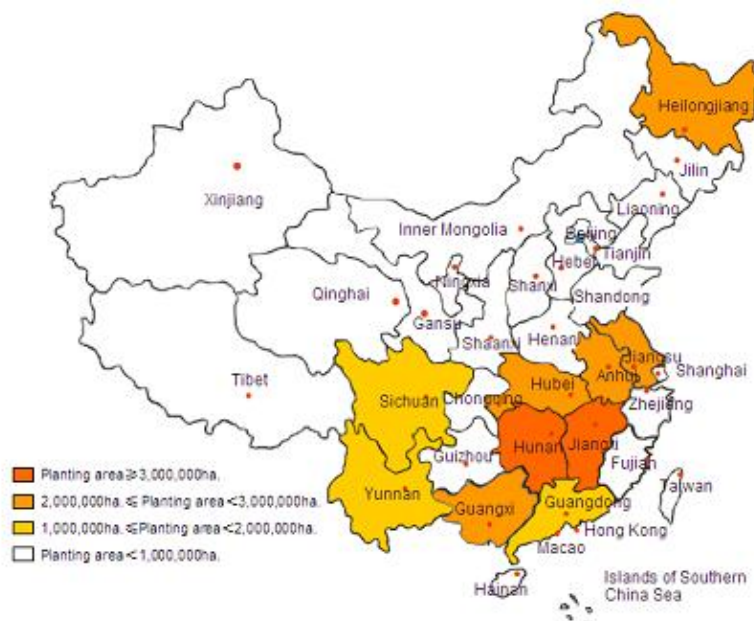


Source:CCM

Rice

Its planting area kept decreasing in 2020–2022, mainly concentrated in the provinces and regions of Hunan, Jiangxi, Jiangsu, Anhui, Guangdong, Hubei, Sichuan, Heilongjiang and Guangxi.

Figure 7.3.2-3 Geographical distribution of rice planting area in China, 2022



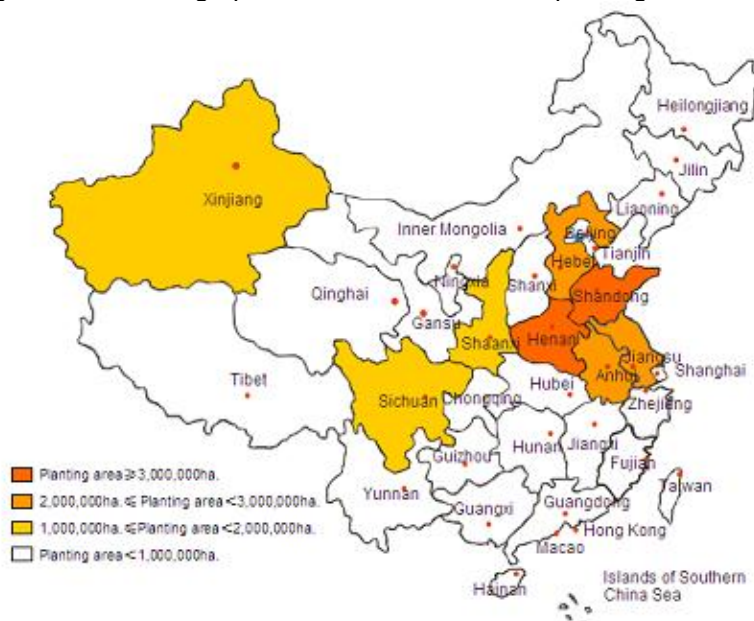
Source:CCM

Glyphosate is used in the field and the field ridges before rice planting. As glyphosate kills the roots of weeds, leading to water and soil loss and resulting in the collapse of the field ridges, most farmers choose paraquat for weeding of rice fields. The consumption of glyphosate in rice fields reached 8,888 tonnes (calculated by 95% technical) in 2022, accounting for 7% of the national total consumption of glyphosate.

Wheat

Its planting area was about 23.5 million hectares in 2022. Wheat planting is mainly concentrated in Henan, Shandong, Anhui, Hebei, Jiangsu, Xinjiang, Sichuan, and Shaanxi provinces, accounting for over 80% of total wheat planting area in the country.

Figure 7.3.2-4 Geographical distribution of wheat planting area in China, 2022



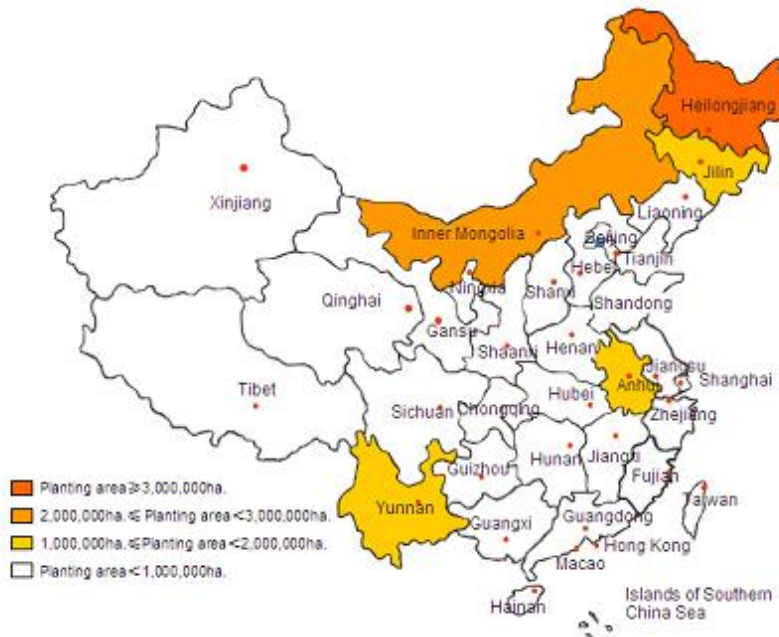
Source:CCM

As glyphosate is only applied in the pre-seeding period of wheat in China, the consumption of glyphosate in wheat fields is small, reaching about 5,850 tonnes (calculated by 95% technical) in 2022, accounting for about 5% of the total.

Beans

Bean planting is mainly located in Heilongjiang, Jilin, Yunnan, Anhui and Inner Mongolia. Generally speaking, glyphosate is used at the pre-emergent stage. Glyphosate consumption in bean fields was about 2,357 tonnes (calculated by 95% technical), accounting for 2% of the national total consumption in 2022.

Figure 7.3.2-5 Geographical distribution of bean planting area in China, 2022



Source:CCM

Cotton

Its planting area was gradually decreased at a CAGR of -2.8% during 2018–2022, dropping to about 3.0 million hectares in 2022. Cotton planting is mainly concentrated in Xinjiang, Shandong, Henan and Hebei provinces.

Figure 7.3.2-6 Geographical distribution of cotton planting area in China, 2022



Source:CCM

In 2022, about 1,060 tonnes of glyphosate (calculated by 95% technical) was used in cotton fields, accounting for 0.8% of the total consumption in China.

Glyphosate is mainly used at two stages, namely the pre-emergent stage and the stage when cotton height is above 70 cm. Farmers mainly use glyphosate to control weeds by placement spraying method.

In Xinjiang and Gansu regions, the height of cotton is about 40 cm–50 cm, much shorter than that in other regions where it is about 90 cm–130 cm. Many farmers smear glyphosate on weeds by brush to put them under control.

Tea

The total planting area of tea in China kept increasing in 2018–2021, but there has been a slight decrease in 2022. The main planting areas are located in Yunnan, Fujian, Sichuan, Zhejiang and Hubei provinces.

Figure 7.3.2-7 Geographical distribution of tea planting area in China, 2022



Source:CCM

Manual cultivation is the traditional and main method for weeding in tea plantations in China, though it costs much time and labour. The weed growth season is in accordance with the peak season of tea making, so the labour is insufficient during this period. Moreover, more and more rural people flow into urban areas, causing a shortage of rural labour. Therefore, some tea plantations also use herbicides, such as glyphosate and paraquat.

Owing to the different action mechanisms between glyphosate and paraquat, they are used in different situations. When tea plantation is on hills or other higher terrain, where protection of water and soil is much needed, planters choose paraquat, but when the plantation is located at even terrain with many weeds, they choose glyphosate.

Usually, tea plantations need to be weeded twice a year, before June and after July.

The consumption of glyphosate is not large as there are many green tea plantations, where the use of agrochemicals is not allowed. In 2022, the consumption of glyphosate in tea plantation was 5,137 tonnes (calculated by 95% technical), accounting for 4% of the total consumption of glyphosate in China.

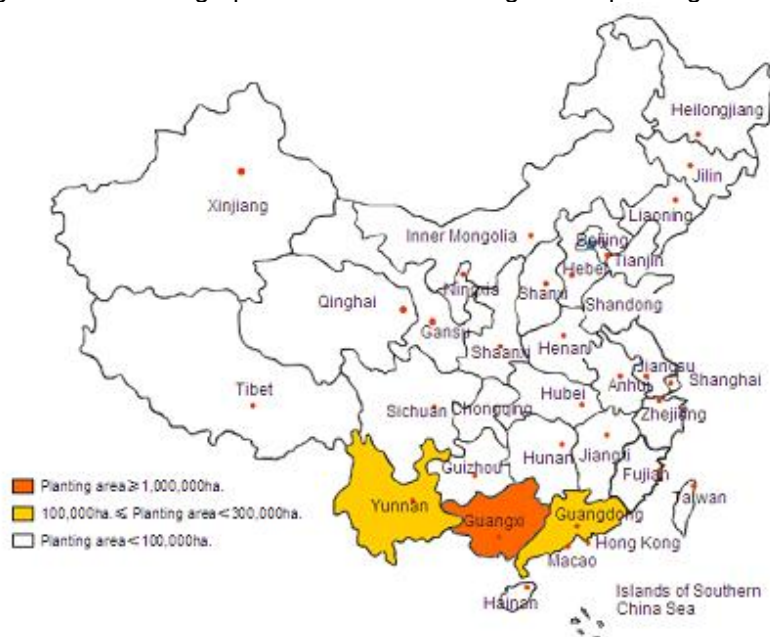
Sugarcane

With the planting area in China gradually decreased at a CAGR of -1.9% during 2018–2022, sugarcane is mainly planted in Yunnan, Guangdong and Guangxi provinces, accounting for over 90% of the country's total planted area in 2022.

Glyphosate is only used before sugarcane planting. After it grows up, farmers use special herbicides or paraquat to control weeds. Some farmers reclaim wasteland to plant sugarcane, which needs much more glyphosate than in common situations. However, this has seldom been seen since sugarcane's profit is not large. As the price of special herbicides is too high, some farmers prefer to use glyphosate.

The consumption of glyphosate in sugarcane fields was about 734 tonnes (calculated by 95% technical) in China in 2022.

Figure 7.3.2-8 Geographical distribution of sugarcane planting area in China, 2022



Source:CCM

Rubber

The total planting area of rubber in China remained stable from 2019 to 2022, with an area of approximately 1.3 million hectares in 2022. Hainan and Yunnan provinces make up over 90% of rubber growing in the country.

2–3 times of weeding is needed for rubber planting every year. About 2,923 tonnes of glyphosate (calculated by 95% technical) was consumed in rubber fields in China in 2022, accounting for about 2% of the total glyphosate consumption in China.

Figure 7.3.2-9 Geographical distribution of rubber planting area in China, 2022



Source:CCM

Other applications of glyphosate in China mainly include non-agricultural uses and wasteland reclamation.

Table 7.3.2-3 Consumption of glyphosate (calculated by 95% technical) in China by crop, 2018–2022, tonne

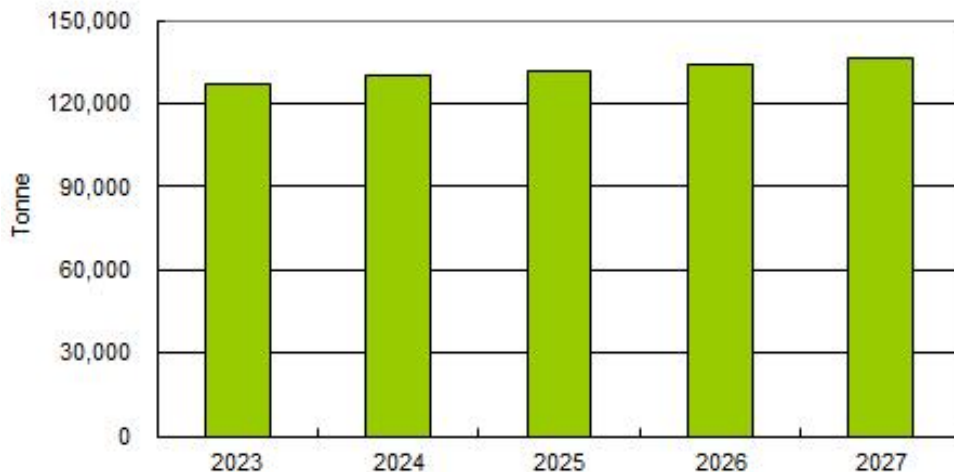
Crop	2018	2019	2020	2021	2022
Orchard	31,625	34,811	38,853	41,812	43,795
Vegetables	18,668	20,308	22,658	22,931	23,596
Corn	9,481	9,575	9,771	10,258	10,198
Rice	8,659	8,691	9,077	9,030	8,888
Wheat	5,589	5,624	5,816	5,863	5,850
Tea	4,650	4,874	5,164	5,240	5,137
Rubber	2,806	2,876	2,923	2,923	2,923
Beans	2,377	2,593	2,668	2,329	2,357
Cotton	1,030	1,068	1,119	1,070	1,060
Sugarcane	739	755	764	748	734
Others	14,375	14,825	16,188	19,796	19,462
Total	100,000	106,000	115,000	122,000	124,000

Source:CCM

7.4 Forecast on glyphosate demand in the next five years

China is highly dependent on imports for grain supply such as soybeans and corn, and in order to meet the growing demand for grain and safeguard food security issues, the demand for GM crops in China has emerged, and the domestic approval of GM products has been significantly accelerated in recent years. In addition, the growing acreage of orchards and tea plantations in China will also drive the demand for glyphosate, so the domestic market demand for glyphosate in China will continue to be positive and is expected to reach 136,000 tonnes in 2027, with a CAGR of 1.7% from 2023 to 2027.

Figure 7.4-1 Forecast on glyphosate demand in China, 2023–2027



Note: Converted to 95% technical.
Source: CCM

8 Profiles of key glyphosate technical producers

8.1 Fuhua Tongda Chemical Co., Ltd. & Nantong Jiangshan Agrochemical & Chemicals Co., Ltd.

Address: Jinsu Town, Wutongqiao District, Leshan City, Sichuan Province, P. R. China

Postcode: 614800

Tel: +86-0833-3186008

Fax: +86-0833-3359989

Website: www.fuhua-tongda.com

Company background

Fuhua Tongda Chemical Co., Ltd. (Fuhua Tongda), established in Leshan City of Sichuan Province in Dec. 2007, specialises in R&D, production and sales of glyphosate and related chemicals. The company's number of staff is about 2,600. It is a shareholder of Nantong Jiangshan Agrochemical & Chemicals Co., Ltd. (Nantong Jiangshan), with a 9.67% shareholding as of April 2023.

Fuhua Tongda's revenue in 2018 was USD677.4 million, which climbed to USD1.4 billion in 2022.

Situation of glyphosate

Fuhua Tongda has three glyphosate technical production lines with a total capacity of 153,000 t/a, and only the glycine route is taken.

The company is also engaged in production of related raw materials and supporting facilities as well, including 300,000 t/a ionic membrane caustic soda, 180,000 t/a phosphorus trichloride, 120,000 t/a dimethyl phosphite, 60,000 t/a paraformaldehyde, 40,000 t/a glycine, 37,500 kW thermoelectric station, 220 t/h steam supply stations, etc. (by Dec. 2022).

Table 8.1-1 Capacity and output of glyphosate technical in Fuhua Tongda, 2018–2022

Item	2018	2019	2020	2021	2022
Capacity, t/a	153,000	153,000	153,000	153,000	153,000
Output, tonne	126,000	129,000	123,000	126,000	130,000

Source:CCM

Nantong Jiangshan has three glyphosate production lines with the capacity of 30,000 t/a (glycine route), 15,000 t/a (IDAN route) and 25,000 t/a (IDAN route) separately. Key raw materials for glyphosate production—glycine and IDAN, are both bought from outside. Paraformaldehyde is mainly supplied by its holding company, Nantong Jiangtian Chemicals Co., Ltd.

Table 8.1-2 Glyphosate technical and its supporting products in Nantong Jiangshan, 2022

No.	Project	Product	Capacity, t/a
1	Glyphosate 30,000 t/a (Glycine route)	Glyphosate technical	30,000
		Phosphorus trichloride	60,000
		DMP	40,000
		Methyl chloride	40,000
		Methylal	18,800
		Hydrochloric acid 31%	90,000
2	Glyphosate 40,000 t/a (IDAN route)	Glyphosate technical	40,000
		Aqueous ammonia 20%	49,252
		Ammonium sulfate	24,477
3	Treatment of phosphorus-containing mother liquor	Mother liquor treatment	45,000
		Sodium pyrophosphate	15,318
		Sodium dihydrogen phosphate	1,074
		Disodium hydrogenorthophosphate	1,338
		Trisodium phosphate	9,363

Source:CCM

Table 8.1-3 Capacity and output of glyphosate technical in Nantong Jiangshan, 2018–2022

Year	Glycine route		IDAN route	
	Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne
2018	30,000	30,000	40,000	36,000
2019	30,000	29,000	40,000	33,000
2020	30,000	30,000	40,000	33,000
2021	30,000	29,000	40,000	33,000
2022	30,000	28,000	40,000	32,000

Source:CCM

8.2 Hubei Trisun Chemicals Co., Ltd.

Address: No. 66-4 Xiaoting Avenue, Xiaoting District, Yichang City, Hubei Province, P. R. China

Postcode: 443007

Tel: +21-51698668 (Foreign trade department)

Company background

Hubei Trisun Chemicals Co., Ltd. (Hubei Trisun), was founded in Sept. 2005, covering an area of 33 ha and has over 730 employees. Its registered capital was RMB200 million as of April 2023.

Currently, Hubei Xingfa Chemicals Group Co., Ltd. holds 100% of the shares of Hubei Trisun.

Table 8.2-1 Main financial metrics of Hubei Trisun, 2018-2022

Item	2018	2019	2020	2021	2022
Revenue, million USD	457	594.6	658.3	1,162.0	1,197.8
Net profit, million USD	22.8	12.5	6.9	201.2	436.7

Source:Hubei Trisun

Situation of glyphosate

Hubei Trisun started glyphosate production in 2008, adopting the glycine route.

Hubei Trisun mainly produces glyphosate technical (capacity in 2022: 130,000 t/a), glyphosate formulations (40,000 t/a), methylal (35,000 t/a), chloromethane (130,000 t/a) and phosphorous acid solution (5,000 t/a). It also produces key upstream products of glyphosate technical, including phosphorus trichloride (190,000 t/a), glycine (100,000 t/a) and dimethyl phosphite (130,000 t/a).

In addition, 90% of Hubei Trisun's glyphosate technical is sold directly, and the rest is made into various formulations.

Table 8.2-2 Capacity and output of glyphosate technical in Hubei Trisun, 2018–2022

Item	2018	2019	2020	2021	2022
Capacity, t/a	130,000	130,000	130,000	130,000	130,000
Output, tonne	110,000	110,000	115,000	122,000	120,000

Source:CCM

8.3 Zhejiang Wynca Chemical Industrial Group Co., Ltd.

Address: No.1 Xin'an Building, Middle Jiangbin Road, Jiande City, Hangzhou City, Zhejiang Province, P. R. China

Postcode: 311600

Tel: +86-571-64723891/64713652/64723949

Fax: +86-571-87220464/64721344

Website: www.wynca.com

Company background

Zhejiang Wynca Chemical Industrial Group Co., Ltd. (Zhejiang Wynca) is a comprehensive enterprise focusing on production of pesticides, chemical products, organic silicone products, etc. It got listed on the Shanghai Stock Exchange in Sept. 2001 (Stock Code: 600596).

Zhejiang Wynca produces more than 100 varieties of products falling into two categories, namely agrochemicals and organic silicone materials. Among agrochemicals, glyphosate technical and formulations play a leading role, and some insecticides and fungicides are also produced. The latter category includes four main series: silicone rubber, silicone oil, silicone resin and silane coupling agent.

Zhejiang Wynca achieved a revenue of USD3.3 billion in 2022.

Situation of glyphosate

Zhejiang Wynca has two production plants of glyphosate, namely Jiande Chemical No. 2 Plant (Jiande Chemical) and Zhenjiang Jiangnan Chemical Co., Ltd. (Zhenjiang Jiangnan) with the glyphosate technical capacity of 30,000 t/a and 50,000 t/a respectively.

Zhejiang Wynca adopts the glycine route to produce glyphosate technical only. Jiande Chemical's 30,000 t/a glyphosate technical installations are equipped with supporting facilities of 30,000 t/a of DMP and 40,000 t/a of phosphorus trichloride. Zhenjiang Jiangnan's 50,000 t/a glyphosate technical installations are equipped with supporting facilities of 50,000 t/a of DMP.

In order to take up more overseas market share, Zhejiang Wynca established some overseas subsidiaries in Argentina, Ghana, Nigeria, the US, Cote d'Ivoire, and Mali.

Table 8.3-1 Capacity and output of glyphosate technical in Zhejiang Wynca, 2018–2022

Plant	Item	2018	2019	2020	2021	2022
Jiande Chemical	Capacity, t/a	30,000	30,000	30,000	30,000	30,000
	Output, tonne	31,000	31,000	31,000	30,000	25,000
Zhenjiang Jiangnan	Capacity, t/a	50,000	50,000	50,000	50,000	50,000
	Output, tonne	50,000	50,000	50,000	50,000	45,000

Source:CCM

8.4 Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.

Address: Binjiang Fine Chemical Park, Qidong City, Jiangsu Province, P. R. China

Postcode: 226221

Tel: +86-513-83885555

Fax: +86-513-83883939

Email: wechem@pub.nt.jsinfo.net

Website: www.good-harvest.cn

Company background

Covering an area of about 430,000 m², with a construction area of more than 100,000 m², Jiangsu Good Harvest-Weien Agrochemical Co., Ltd. (Jiangsu Good Harvest) focuses on the production of agrochemicals and fine chemicals.

Jiangsu Good Harvest has over 700 staffs, around 200 of which are technicians. Its key products and capacities in 2022 are as follows:

- Phenmedipham technical: 1,000 t/a
- Desmedipham technical: 1,000 t/a
- Ethofumesate technical: 1,000 t/a
- N-butyronitrile and Isobutyronitrile: 2,500 t/a
- 2,4-D dimethylamine salt: 2,500 t/a
- Glyphosate technical: 62,000 t/a
- Glyphosate formulations: 29,000 t/a

Situation of glyphosate

Jiangsu Good Harvest adopts IDA pathway to produce glyphosate technical, with a capacity of 62,000 t/a. Currently, it mainly purchases PMIDA for producing glyphosate technical.

- 32,000 t/a line takes IDAN to produce PMIDA and then glyphosate technical, or takes PMIDA to produce glyphosate technical directly.
- 30,000 t/a line takes PMIDA to produce glyphosate technical.

Table 8.4-1 Capacity and output of glyphosate technical in Jiangsu Good Harvest, 2018–2022

Item	2018	2019	2020	2021	2022
Capacity, t/a	62,000	62,000	62,000	62,000	62,000
Output, tonne	38,000	30,000	30,000	30,000	26,000

Source:CCM

8.5 Leshan Hebang Agricultural Technology Co., Ltd.

Address: Niuhua Town, Wutongqiao District, Leshan City, Sichuan Province, P. R. China
Postcode: 614801
Tel: 86-0833-3208293
Fax: 86-0833-3207446
Website: www.hebang.cn

Company background

Leshan Hebang Agricultural Technology Co., Ltd. (Leshan Hebang) was established in 2013, owned by Sichuan Hebang Biotechnology Co., Ltd. (Hebang Biotechnology).

Hebang Biotechnology got listed in Shanghai Stock Exchange in 2012 (Stock code: 603077).

Glyphosate and PMIDA are key products of Leshan Hebang and it has become one of key glyphosate player in China with a capacity of 50,000 t/a glyphosate technical and 180,000 t/a PMIDA.

Situation of glyphosate

In 2015, Leshan Hebang started to produce glyphosate technical through IDAN route, which uses IDAN as the raw material to produce PMDIA and then glyphosate technical. It owns a production capacity of 180,000 t/a PMDIA in 2022, with the output of PMIDA dropping to 105,000 tonnes from 114,000 tonnes in 2021. So far, Leshan Hebang has two production lines of glyphosate technical with a total capacity of 50,000 t/a.

Most of glyphosate technical produced by Leshan Hebang is sold at home and only a few are exported to the overseas market. Its glyphosate technical export volume was 368 tonnes in 2022.

Table 8.5-1 Capacity and output of glyphosate technical in Leshan Hebang, 2018–2022

Item	2018	2019	2020	2021	2022
Capacity, t/a	50,000	50,000	50,000	50,000	50,000
Output, tonne	55,000	55,000	50,000	50,000	50,000

Source:CCM

8.6 Jiangsu Yangnong Chemical Co., Ltd.

Address: No.39 Wenfeng Road, Yangzhou City, Jiangsu Province, P. R. China
Postcode: 225009
Tel: +86-514-85888888/85889958
Fax: +86-514-85881788/85889900
Website: www.yangnongchem.com/

Company background

Jiangsu Yangnong Chemical Co., Ltd. (Jiangsu Yangnong), established in Dec. 1999 and listed on the Shanghai Stock Exchange in April 2002 (Stock Code: 600486), is engaged in the R&D and production of chemicals used in agricultural and public health sectors.

Pyrethroids for sanitary use or agricultural use are the key products of Jiangsu Yangnong, with a capacity of 8,000 t/a. It can provide 60 or more species of this kind of products.

In 2018–2020, Jiangsu Yangnong achieved annual revenues of approximately USD1.3 billion–USD1.4 billion; since then, the revenue grew rapidly to USD1.8 billion in 2021 and even more to USD2.4 billion in 2022.

Situation of glyphosate

Jiangsu Yangnong started to research glyphosate production technology since 2003. It is the earliest glyphosate supplier to adopt the IDA pathway in China. Jiangsu Yangnong purchases DEA as raw material for the production of PMIDA and then glyphosate technical. In addition, it's equipped with facilities for PMIDA production from IDAN.

Its glyphosate produced from DEA shows good product quality and is well accepted in the overseas market. The company's export volume of glyphosate technical remained stable at around 30,000 tonnes during 2018–2022.

Table 8.6-1 Capacity and output of glyphosate technical in Jiangsu Yangnong, 2018–2022

Item	2018	2019	2020	2021	2022
Capacity, t/a	35,000	35,000	35,000	35,000	35,000
Output, tonne	32,000	30,000	30,000	30,000	30,000

Source:CCM

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