CHINA AGRICULTURE

Seeds - maximizing yield potential

Seeds are the core of agriculture, and provide key support to China's long-term food security. While bio-tech seeds are not the only driver of seeds performance, we believe the potential introduction of 1st generation bio-tech seeds in China will drive the start of yield enhancement and trigger rapid industry restructuring, paving the way to incentivize and accelerate the development of better seeds that maximize crop yield potential and output in the long run. Our scenario analysis suggests an incremental 28mnt of corn output by 2027E, from the 1st generation of GM seeds, equivalent to current Chinese imports.

We also see the bio-tech development of GM seeds accelerating the consolidation of China's seed industry, and bringing stronger pricing power along the way. Based on approved bio-tech traits and regional coverage, we expect bio-tech trait owners - including DBN, Ruifeng/Longping, and Syngenta - to control prevailing market shares, and become key beneficiaries.

We initiate coverage on DBN (Buy) and Denghai (Neutral), and downgrade Longping to Sell from Neutral.

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We expect the 1st generation of GM seeds in China – most of which are insect resistant and herbicide tolerant - to bring a yield improvement of 10% on average for corn and 5% for soybean, a significant reduction in both herbicide and pesticide costs (including weed management), as well as lower mycotoxin in the grain produced. In the longer term, we estimate GM seeds can potentially bring a 30-60% improvement in Chinese corn yield from the current level of ~421kg/mu, as bio-tech traits, germplasm, and precision farming work together to revolutionize the efficiency of grain production in China. The rapid development of bio-tech tools in recent years, including lower cost gene sequencing, CRISPR-Cas9, AI, etc., should enable and accelerate more advanced seed breeding.

We also see the bio-tech development of GM seeds accelerating the consolidation of China's seed industry, and bringing stronger pricing power along the way. The prevailing trait advantages and economic benefits carried through GM seeds should enable rapid market share gains by the top seed performers, and accelerate the elimination of the long tail end of the much fragmented industry supply. Nevertheless, we expect consolidation among bio-tech traits suppliers will be most significant, while competition among germplasm owners will likely remain intense. We expect bio-tech trait owners – including DBN and Ruifeng/Longping, and Syngenta (Not Covered) – to control prevailing market shares, and become key beneficiaries.

With the economic value created from GM seeds to farms and the improved industry supply outlook, we expect 1st generation GM seeds to lead to 30-40% seed value appreciation, and potentially ~80% in the long term, which would translate to potential seed revenue growth from Rmb0.6bn to Rmb3.3bn (or 34% CAGR) for DBN, from Rmb1.1bn to Rmb3.4bn for Denghai (or 21% CAGR), and from Rmb3.5bn to Rmb6.3bn for Longping (or 10% CAGR) during 2021A-2027E. Accordingly, our analysis suggests this would translate to earnings upside of 4-16% for Dabeinong, 2-18% for Denghai, 2-18% for Longping, and 27-33% upside to valuations.

We initiate DBN at Buy with a 12-month target price of Rmb13.60/sh (89% upside), Denghai at Neutral with a TP of Rmb22.70/sh (12% upside), and downgrade Longping to Sell from Neutral as we lower our TP to Rmb12.50/sh from Rm14.20/sh (17% downside).

China Seeds
in numbers

FOOD DEMAND

27% Higher daily meat consumption to reach per capita protein demand in China for the long-term.

68% of net import in grain equivalent term needed, as percentage of China's total arable land.

BIOTECH SEED STATUS IN CHINA

14 traits

for corn and soybean seeds, have received bio-security safety approval from MOA since 2019.

7-10 years

of field testing and lab research needed for new GMO traits to be approved in China.

Rmb226-389/mu
higher income,

through 1st gen GMO corn traits, according to field study performed by Dabeinong.

5x of illegal gain
(max. Rmb5mn)

penalty applied for IP infringement of plants in China, according to the new Seed Law.

1100

existing corn seed producers in China, with Top 10 comprising 25% of the market share.

2-3 years

of breeding time needed, compared to 7-8 years previously, due to advanced technologies like gene-sequencing, and AI-facilitated phenotype screening.

BIOTECH SEED STATUS OVER THE GLOBE

31-79% of GMO adoption rate
in terms of arable land

for corn, soybean, and cotton planting worldwide.

65% higher corn seed prices
in US post GMO

a result of net benefit attributed to yield improvement, reduction in pesticides use, and cost saving in herbicides application, and more conservation tillage.

AGRICULTURAL SUPPLY

421kg/mu
in 2020/2021 planting year,

corn output in China, versus output of 720kg/mu in US, and 504kg/mu in Argentina.

5% yield loss
of current domestic production in corn

due to pests, drought, and extreme weather conditions.

36% as of total arable land

corn is planted as the single largest grain product in China during 2020/2021 planting year.

469kg/mu
in 2020/2021 planting year,

rice output in China, versus output 443kg/mu in Japan, and 264kg/mu in India.

5-10% potential yield improvement

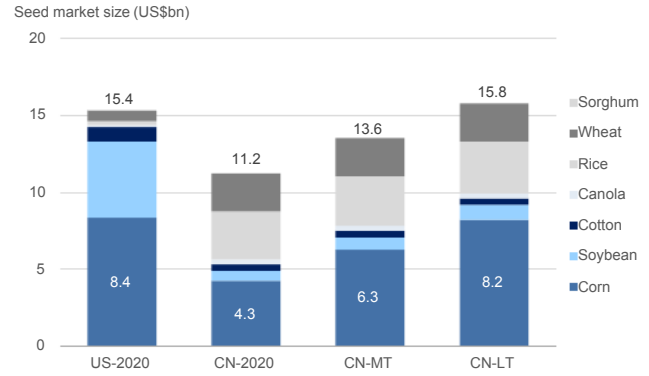
through the introduction of 1st gen GMO seeds in China, versus. 30% improvement in US during the first 15 years post GM commercialization.

2.5x/3.0x *in 2020A*

China's use of fertilizer/pesticide per hectare of land vs. global average, according to FAO data.

Focus charts – seeds

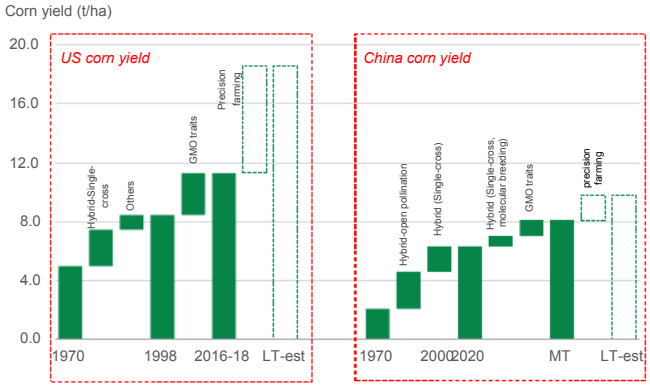
Exhibit 1: Seed market size – China vs US



MT = medium term (2027E); LT = long term (2030E onward)

Source: NBS, Wind, Goldman Sachs Global Investment Research

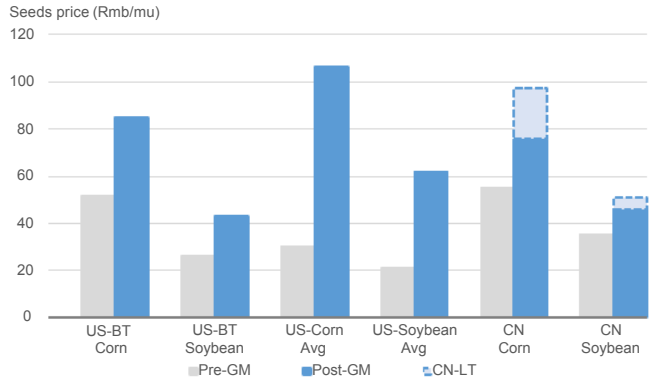
Exhibit 2: Corn yield change – US vs. China



MT = medium term (2027E); LT = long term (2030E onward)

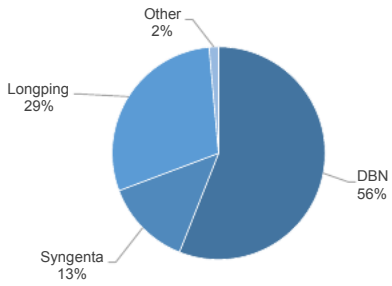
Source: USDA, FAO, MOA, Goldman Sachs Global Investment Research

Exhibit 3: Seeds price improvement post GMO – US and China



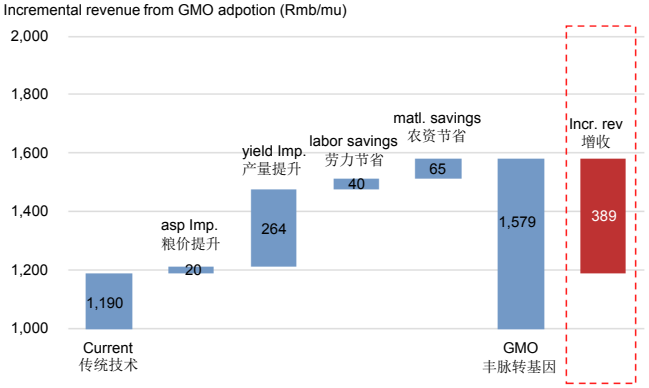
Source: USDA , MOA, Company data, Goldman Sachs Global Investment Research

Exhibit 4: Market share on corn GM traits – medium term, estimated based on weighted average of traits and regional approvals (as of 1H22)



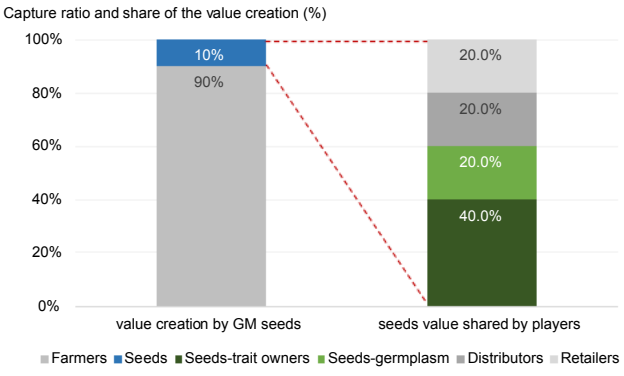
Source: MOA, Company data, Goldman Sachs Global Investment Research

Exhibit 5: Seed economics – DBN3601T for tropical corn in Southwest China



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 6: GM seeds valuation created



Source: Company data, Goldman Sachs Global Investment Research

Stock exposures – seeds

Exhibit 7: China seed coverage summary

Stock/ticker		Key financials				Investment thesis
Dabeinong		Year	Rev	NP	GM	Dabeinong (DBN) is a diversified agriculture products producer involved in animal feed, hog farming, seed breeding and other businesses. We expect strong topline revenue and earnings growth ahead, with a CAGR of 21-58% during 2023E-2025E in our base, non-GMO case, driven by its accelerated feed volume growth, and improvement in hog operation from being loss making in 2021A. We view DBN as the best positioned to capture the shared economic benefits from the potential introduction of 1st generation corn GM seeds in China in the coming years. Its long-term commitment in seed breeding should underpin sustainability of its leading position in China's seed sector. We initiate coverage on Dabeinong with a Buy rating and 12-month target price of Rmb13.6/sh, which includes Rmb9.1/sh from the traditional business and Rmb4.5/sh from GMO.
大北农			Rmb mn	Rmb mn	%	
002385.SZ		2021A	31,328	(440)	12.9%	
		2022E	37,794	(300)	13.5%	
Segment	Seeds	2023E	45,541	597	13.5%	
Ratings	Buy	2024E	56,295	1,326	13.5%	
Target	Rmb13.6	2025E	66,497	1,614	13.5%	
Upside	89%	CAGR	20.7%	n.a.	0.6%	
Denghai		Year	Rev	NP	GM	Denghai is one of the largest corn seed producers in China, with a unique long, established strength in corn germplasm seeds. We expect the company to benefit from the industry consolidation post the potential launch of 1st generation GM seeds, although the incremental benefit would be much smaller than for bio-tech traits owners. In the near term, we see decelerating cyclical momentum on corn seeds, with positive volume growth but muted margin expansions. We initiate coverage on Denghai with a Neutral rating and 12-month target price of Rmb22.7/sh, including Rmb16.0/sh from its conventional business and Rmb6.7/sh from GMO.
登海种业			Rmb mn	Rmb mn	%	
002041.SZ		2021A	1,101	233	36.3%	
		2022E	1,672	347	38.6%	
Segment	Seeds	2023E	1,976	407	38.7%	
Ratings	Neutral	2024E	2,266	475	38.8%	
Target	Rmb22.7	2025E	2,546	545	38.9%	
Upside	12%	CAGR/Diff.	23.3%	23.7%	2.6%	
Longping		Year	Rev	NP	GM	Longping is the dominant player in China's hybrid seed industry, with c.7% market share in domestic rice seed and 7% share in hybrid corn seed as of FY21.We revise down Longping's earnings by 37-126% for 2022E-2024E to incorporate lower margin assumptions for both corn and rice seeds, as a result of market share gain, competition, amid cost inflation. We remain positive on the outlook of potential introduction of corn GM seeds in the domestic market, yet we see lower economics benefit on Longping versus its major peers given its decelerating effort as reflected on its lower shares of Longping Bio-Tech ("隆平生物") and declining R&D spending. We downgrade the stock to Sell with a revised target price of Rmb12.5 (from Rmb14.2/sh), implying 17% downside versus current price.
隆平高科			Rmb mn	Rmb mn	%	
000998.SZ		2021A	3,503	62	34.3%	
		2022E	3,799	(59)	36.7%	
Segment	Seeds	2023E	4,384	142	37.4%	
Ratings	Sell	2024E	4,744	256	38.2%	
Target	Rmb12.5	2025E	5,117	395	38.9%	
Upside	-17%	CAGR/Diff.	9.9%	58.6%	4.6%	

Pricing as of Aug 5th

Source: Company data, Goldman Sachs Global Investment Research

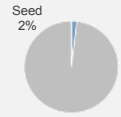
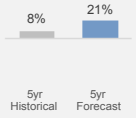
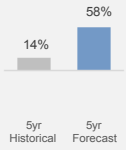
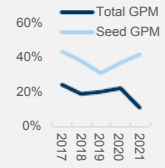
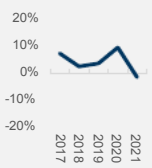
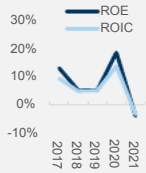
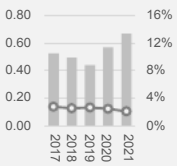
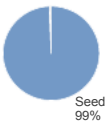
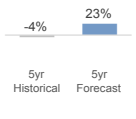
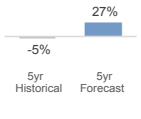
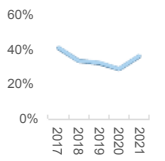
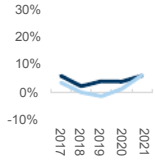
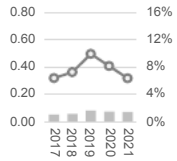
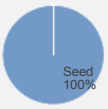
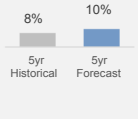
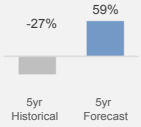
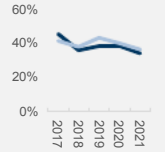
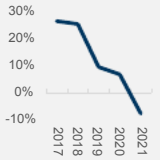
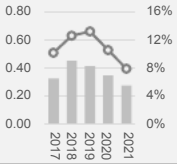
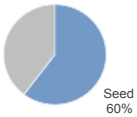
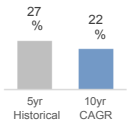
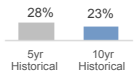
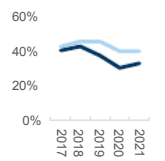
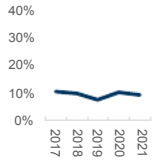
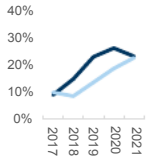
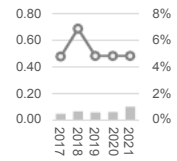
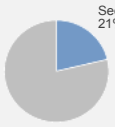
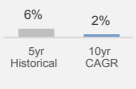
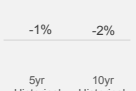
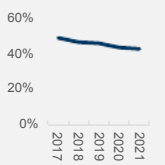
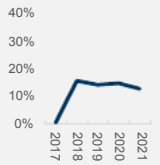
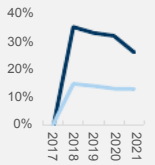
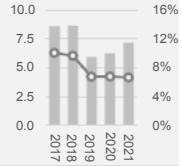
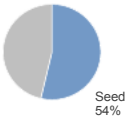
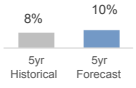
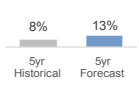
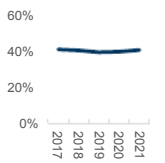
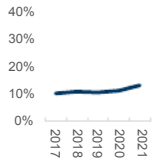
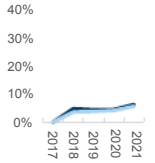
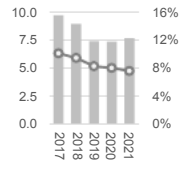
Exhibit 8: Valuation peers - seed

Company	Ticker	Rating	Target	Price	ccy	Upside	Mkt cap	PE			PB		ROE		EV/EBITDA			Div yield			YTD
Price as of 5-Aug-2022							US$ mn	21A	22E	23E	21A	22E	21A	22E	21A	22E	23E	21A	22E	23E	%
China Seeds																					
Longping	000998.SZ	Sell	12.5	15.1	CNY	-17%	2,947	318.9	n.a.	140.5	3.6	3.6	1%	-1%	60.1	n.a.	39.8	0.0%	0.0%	0.0%	-36%
Dabeinong	002385.SZ	Buy	13.6	7.2	CNY	89%	4,401	n.a.	n.a.	49.8	2.7	2.8	-4%	-3%	13.9	97.3	41.4	0.6%	0.0%	0.0%	-31%
Denghai	002041.SZ	Neutral	22.7	20.3	CNY	12%	2,648	76.8	51.5	43.9	6.2	5.8	8%	11%	165.9	72.1	49.2	0.2%	0.2%	0.4%	-21%
Winall	300087.SZ	NC	NA	15.4	CNY	NA	1,543	59.1	30.7	22.9	7.6	3.8	18%	13%	33.0	20.2	n.a.	0.8%	1.0%	1.4%	-27%
Wanxiang Donned	600371.SS	NC	NA	13.5	CNY	NA	582	n.a.	n.a.	n.a.	n.a.	n.a.	7%	0%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-3%
JS Prvnl Agricultural	601952.SS	NC	NA	13.5	CNY	NA	2,756	25.4	19.2	17.2	3.2	2.9	13%	15%	11.2	9.9	n.a.	1.8%	1.9%	2.4%	11%
Fengle Seed	000713.SZ	NC	NA	9.2	CNY	NA	835	n.a.	n.a.	n.a.	n.a.	n.a.	10%	0%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-9%
Nongfa	600313.SS	NC	NA	10.3	CNY	NA	1,645	n.a.	n.a.	n.a.	n.a.	n.a.	2%	0%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	102%
Dunhuang	600354.SS	NC	NA	6.1	CNY	NA	475	n.a.	n.a.	n.a.	n.a.	n.a.	1%	0%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-7%
Average								**120.1**	**33.8**	**54.9**	**4.7**	**3.8**	**6%**	**4%**	**56.8**	**49.9**	**43.4**	**0.7%**	**0.6%**	**0.8%**	**-2%**
Global Seeds																					
Corteva	CTVA	Neutral	61.0	55.2	USD	10%	40,360	25.6	23.0	19.0	1.7	1.6	6%	6%	9.3	11.5	12.9	1.8%	1.2%	1.1%	22%
Bayer AG	BAYGn.DE	Buy	81.0	57.3	EUR	41%	57,463	8.8	7.4	7.0	1.8	1.7	3%	14%	9.1	8.8	7.7	3.4%	4.0%	3.5%	21%
Bioceres	U:BIOX	NC	NA	11.1	USD	NA	686	n.a.	221.6	21.3	n.a.	n.a.	-12%	0%	12.0	6.0	3.9	n.a.	n.a.	n.a.	-26%
KWS SAAT	D:KWS	NC	NA	61.0	EUR	NA	2,046	18.2	18.3	15.8	1.9	1.8	11%	10%	11.0	9.6	n.a.	1.4%	1.5%	1.6%	-18%
Sakata	1377.T	NC	NA	4,735	JPY	NA	1,658	17.2	24.2	21.7	1.7	n.a.	7%	0%	n.a.	n.a.	n.a.	1.0%	1.4%	n.a.	47%
Average								**17.4**	**58.9**	**17.0**	**1.8**	**1.7**	**3%**	**6%**	**10.3**	**9.0**	**8.1**	**1.9%**	**2.0%**	**2.1%**	**9%**

Pricing as of Aug 5,2022. NC=Not Covered; estimates for NC and NR companies are from Datastream

Source: Datasream, Company data, Goldman Sachs Global Investment Research

Exhibit 9: Peer comparsion - seeds

Companies Unit	Revenue mix %	Rev growth %	NP growth %	Total/seed GPM %	EBIT Margin %	ROE and ROIC %	R&D Rmb bn/(%)
Dabeinong 大北农 (002385.SZ)							
Denghai 登海种业 (002041.SZ)							
Longping 隆平高科 (000998.SS)							
Winall 荃银高科 (300087.SZ)							
Sygenta 先正达 Unlisted							
Corteva 科迪华 (CTVA)		*calculated using 2024E 					

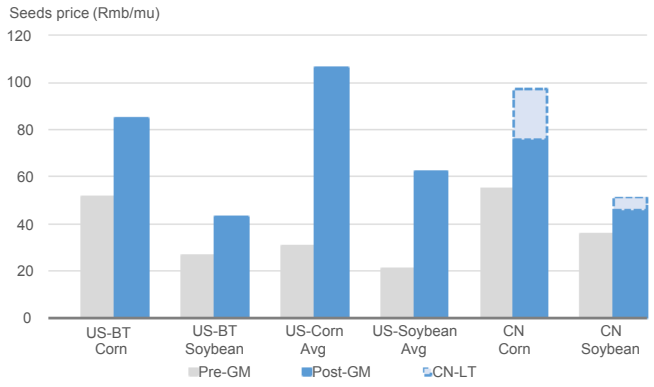
Source: Company data, Goldman Sachs Global Investment Research

The start of value appreciation on seeds

The value of seeds reflects the economic benefits they bring to farmers. Due to lower yield and lack of a prevailing traits advantage in crops, seed prices for major grains such as corn and soybean in China have been 40-80% lower than in the US, ranging between Rmb29-51/mu (or US$63-118/ha), according to data from the Ministry of Agriculture (MOA). Nevertheless, we expect seed prices to rise by ~30-40% in the coming years, as the development and implementation of bio-tech traits starts to revolutionize efficiency in grain production in China. The improving economics for farmers, in terms of maximizing the yield potential of grain, and reducing the cost of inputs, would thus enable seeds to capture a bigger part of the benefit than ever. Among all seeds, we view the outlook for corn seeds as most attractive, given its earlier participation in the bio-tech traits, low penetration, self-protective nature of the IP, and the largest planting acreage globally among major grains.

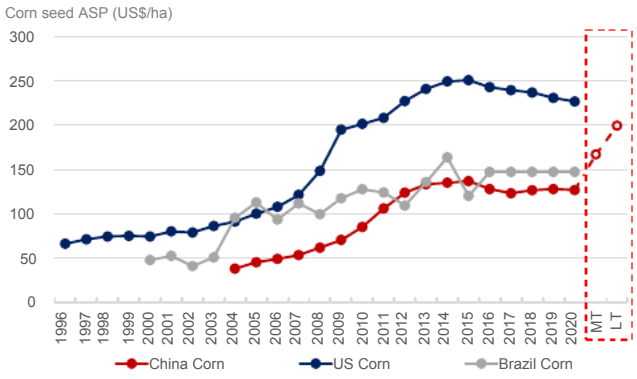
However, seed value is not just about bio-tech traits. While IP enforcement in China still has significant room to improve, in our view, ongoing germplasm advancement, and future generation traits, could lead to ~40-80% upside seed prices in China from the current level in the longer run, if we benchmark to peer countries.

Exhibit 10: Seed price improvement post GMO – US and China



Source: USDA , MOA, Company data, Goldman Sachs Global Investment Research

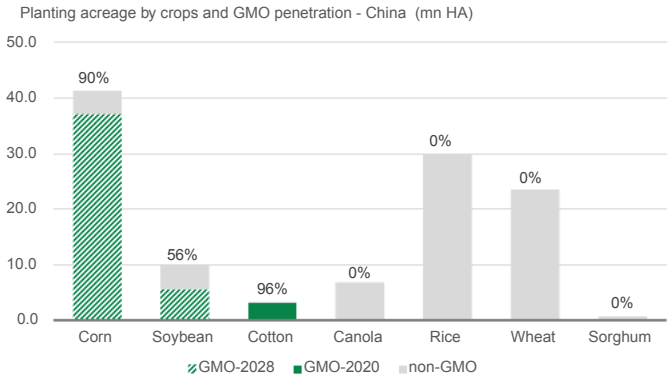
Exhibit 11: Corn seed prices – China, US and Brazil



MT= Medium term (2027E); LT= Long term (2030E)

Source: USDA, MOA, Goldman Sachs Global Investment Research

Exhibit 12: Planting area by crop and potential GM penetration – China



Source: MOA, Goldman Sachs Global Investment Research

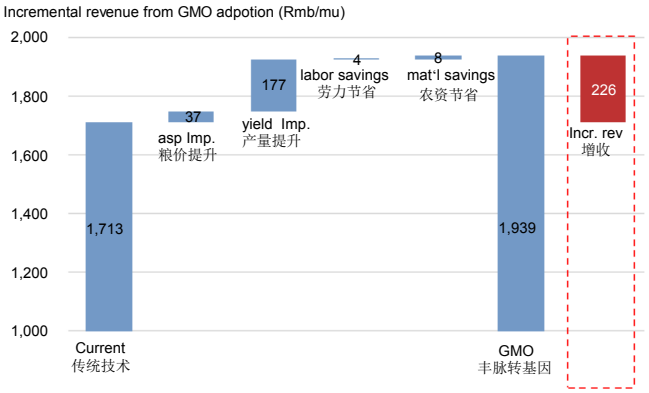
Economics of better seeds

The economics of better seeds translates into a net benefit for farmers, in the form of higher yield, reduction of inputs such as pesticides/herbicides (BT and HT traits), savings in labor costs, and less tillage. In China, producers also noted reduction in mycotoxin (霉菌毒素) in the grain produced, which would in term translate to higher selling prices. Seeds suppliers, including the bio-tech trait owners, germplasm owners/seeds producers, distributors and retailers, would therefore be able to capture a portion (capture ratio) of this economic benefit, potentially bring a yield improvement of 10% on average for corn and 5% for soybean, a significant reduction in both herbicide and pesticides cost including weed management, as well as lower mycotoxin in the grain produced.

Based on feedback of field tests and public commentary from China's MOA, we expect the 1st generation GM seeds in China could potentially bring a yield improvement of 10% on average for corn and 5% for soybean, combined with 50% in cost savings for weed control. For farmers, these changes would translate to a net benefit of ~Rmb3,100 per hectare (or Rmb205/mu) in corn production, and ~Rmb1,300 per hectare (or Rmb85/mu) for soybean, on our estimates. We estimate these changes therefore could lead to Rmb10-20/mu in higher seed prices, assuming a 10% capture ratio.

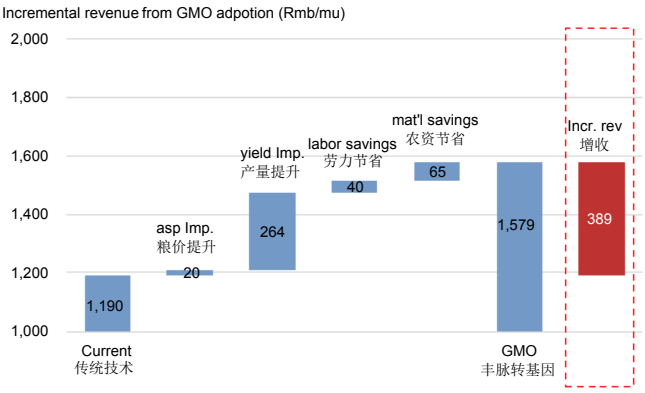
- Per MOA comments at a State Council press conference (Jan, 2022) tests for GM BT/HT (for army worms) corn seed suggests 95% effectiveness in herbicide resistance and army worm resistance, leading to a 12% yield improvement, and a significant reduction in both herbicide and pesticides costs.
- In a GM corn seed study performed by DBN, its 1st generation traits brought 10-15% higher yield by reducing yield losses caused by pests, reduced mycotoxin by 80% (thus 2-4% better grain quality), and also improved production efficiency by 10-15% – all translating into Rmb226-389 higher income for farmers for each mu of corn planted. In its southwest corn tests, the improvement reached Rmb389 per mu, driven by higher yield recovery from the army worm impact.

Exhibit 13: Seed economics – DBN9936 for spring corn in Northeast China



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 14: Seed economics – DBN3601T for tropical corn in Southwest China



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 15: GMO seed value creation and seed price - Corn

Corn					
Economic benefit	**Unit**	**Low case**	**1st gen GM**	**High case**	**LT case**
GMO - yield	%	5%	10%	15%	17%
Germplasm - yield	%	0%	0%	0%	11%
Value added per hectare					
GMO - yield	Rmb/ha	908	1,817	2,725	3,078
Germplasm - yield	Rmb/ha	-	-	-	2,033
GMO-weed cost saving	Rmb/ha	1,350	1,350	1,350	1,350
Total	Rmb/ha	2,258	3,167	4,075	6,461
Translating to seed price					
GMO - yield	Rmb/kg	4.0	8.1	12.1	13.7
Germplasm - yield	Rmb/kg	0.0	0.0	0.0	9.0
GMO-weed cost saving	Rmb/kg	6.0	6.0	6.0	6.0
Among seed suppliers	**Rmb/kg**	**10.0**	**14.1**	**18.1**	**28.7**
GMO trait owner	Rmb/kg	4.0	5.6	7.2	7.9
Germplasm owner	Rmb/kg	2.0	2.8	3.6	9.4
Distributor	Rmb/kg	4.0	5.6	7.2	11.5
Among seed suppliers		**15.1**	**21.1**	**27.2**	**43.1**
GMO trait owner	Rmb/mu	6.0	8.4	10.9	11.8
Germplasm owner	Rmb/mu	3.0	4.2	5.4	14.0
Distributor	Rmb/mu	6.0	8.4	10.9	17.2
as% of current seed price	**%**	**28%**	**39%**	**50%**	**79%**

Source: USDA, Bloomberg, Goldman Sachs Global Investment Research

Exhibit 16: GMO seed value creation and seed price - Soybean

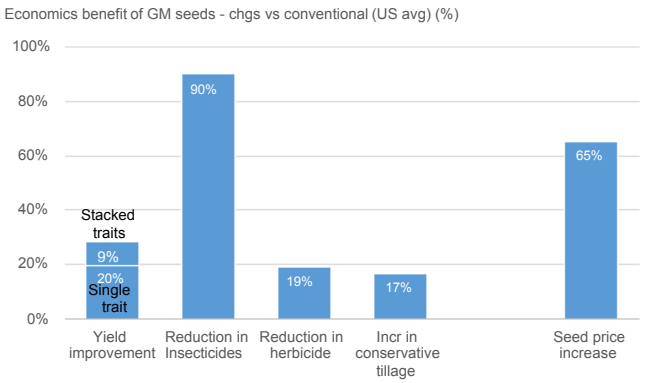
Soybean					
Economic benefit-SOYB.	**Unit**	**1st gen GM**	**Mid case**	**High case**	**LT case**
GMO - yield	kg/ha	5%	10%	15%	13%
Germplasm - yield	kg/ha	0%	0%	0%	0%
Value added per hectare					
GMO - yield	Rmb/ha	519	1,038	1,557	1,271
Germplasm - yield	Rmb/ha	-	-	-	-
GMO-weed cost saving	Rmb/ha	945	945	945	945
Total	Rmb/ha	1,464	1,983	2,502	2,216
Translating to seed price					
GMO - yield	Rmb/kg	0.7	1.4	2.1	1.7
Germplasm - yield	Rmb/kg	0.0	0.0	0.0	0.0
GMO-weed cost saving	Rmb/kg	1.3	1.3	1.3	1.3
Among seed suppliers	**Rmb/kg**	**2.0**	**2.6**	**3.3**	**3.0**
GMO trait owner	Rmb/kg	0.8	1.1	1.3	1.2
Germplasm owner	Rmb/kg	0.4	0.5	0.7	0.6
Distributor	Rmb/kg	0.8	1.1	1.3	1.2
Among seed suppliers		**9.8**	**13.2**	**16.7**	**14.8**
GMO trait owner	Rmb/mu	3.9	5.3	6.7	5.9
Germplasm owner	Rmb/mu	2.0	2.6	3.3	3.0
Distributor	Rmb/mu	3.9	5.3	6.7	5.9
as% of current seed price	**%**	**27%**	**36%**	**46%**	**41%**

Source: USDA, Bloomberg, Goldman Sachs Global Investment Research

Beyond the potential 1st generation GM seeds, we see further upside to value creation and seed prices, driven by more advanced bio-tech seeds based on multi-genes modification or gene-editing, ongoing germplasm optimization, and other factors such as precision farming practices.

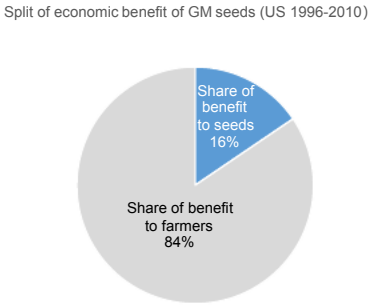
US GM history provides an optimistic case for the aggregated changes in GM benefits over time. Based on a USDA study following the first 15 years post the commercialization of GM seeds in the US (1996-2010), adoption of GM seeds has brought nearly a 30% yield improvement in corn (through both single traits and stacked traits), a 90% reduction in pesticides use, along with cost savings in herbicides application, and more conservation tillage (a practice that reduces the carbon footprint and soil degradation, and improves soil water retention). As a result, US corn seed prices increased by 65% over the period, with a capture ratio of 16% for the incremental value created, nearly double versus pre-GM years.

Exhibit 17: Economic benefit of GM corn seeds (US 1996-2010)



Source: USDA, Goldman Sachs Global Investment Research

Exhibit 18: Shares of the incremental economic benefit of GM seeds (US 1996-2010)



Source: USDA, Goldman Sachs Global Investment Research

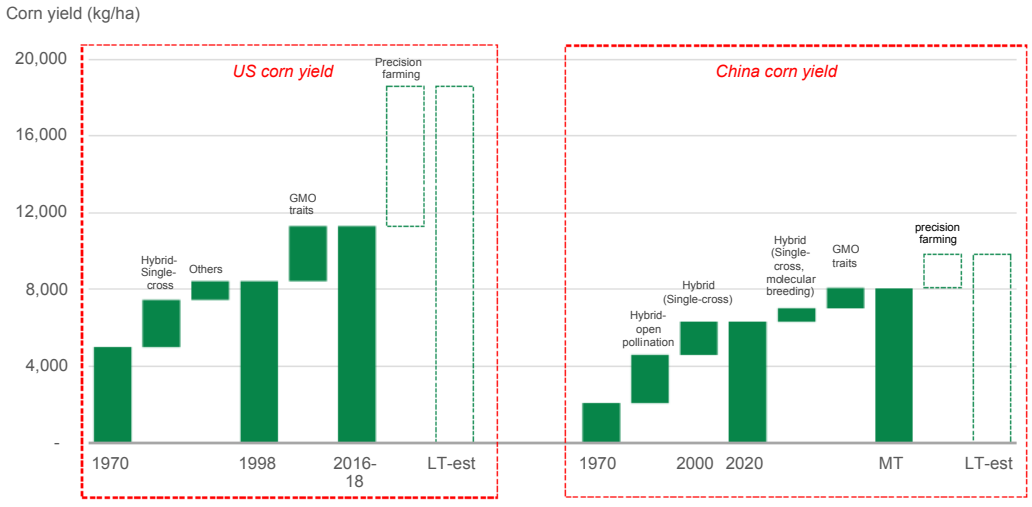
Gauging yield potential in China

Corn yield in China is currently 6.3t/ha (based on FAO data), versus 8.5-10.5t/ha in peak performing peers such as the US and Argentina. Seeds with bio-tech traits, including GM seeds, enable the crops to reach their yield potential, by mitigating the losses associated with pests or other negative planting factors. However, there are many critical factors for yield, including germplasm that set the intrinsic yield potential, as well as precision farming practices. Nevertheless, the start of bio-tech seeds, that is likely to trigger enhanced IP enforcement in China, could jump-start the acceleration of yield improvement in the long term, in our view.

To gauge the potential yield upside, we reference both the yield improvement post the introduction of GM seeds in the US, Argentina, and Brazil. In addition, the estimated annual yield loss in China due to pests or extreme weather may also benchmark the near-term improvement, when part of the losses could be addressed by 1st generation GM seeds in China. Based on the history of the US/South America technology adoption and yield history, we estimate China yield potential by taking a 50-67% discount to the US yield gain from germplasm, bio-tech seeds, and precision farming over time, to reflect the more challenging planting conditions in China, the weakness in industry germplasm development, and the early stage of precision farming. Recognizing the challenges, we highlight that China has an advantage by utilizing the more advanced technologies that were not available 30 years ago, such as low-cost gene-sequencing, and AI-facilitated phenotype screening, that could shorten the breeding cycle of new species from 7-8 years to 2-3 years.

As a result, we estimate Chinese corn yield could potentially see a 30% improvement and reach ~8.0t/ha if based on GM seeds technology, and close to 10t/ha if combined with precision farming practices – which would still be a significant almost 60% improvement if achieved.

Exhibit 19: Corn yield change – US and China

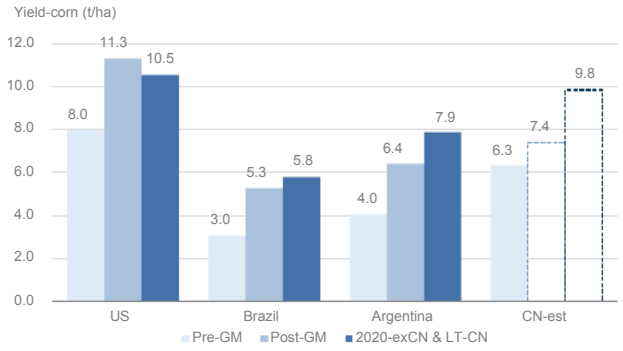


Source: USDA, FAO, MOA, Goldman Sachs Global Investment Research

At present, yields of major grains such as corn and soybean are 20-40% lower in China versus peers, yet very strong for rice and wheat versus peers (partly due to stronger

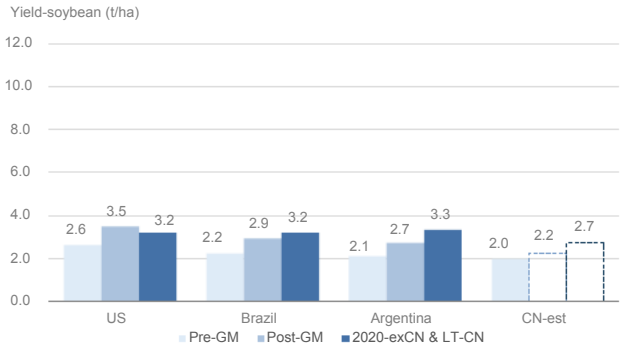
germplasm development). Visibility of a 10% improvement in yield is relatively high, in our view, given the field tests of the 1st generation GM seeds, and the fact that nearly one-third of the arable land each year in China is affected by pests and extreme weather.

Exhibit 20: Corn yield – China versus peers



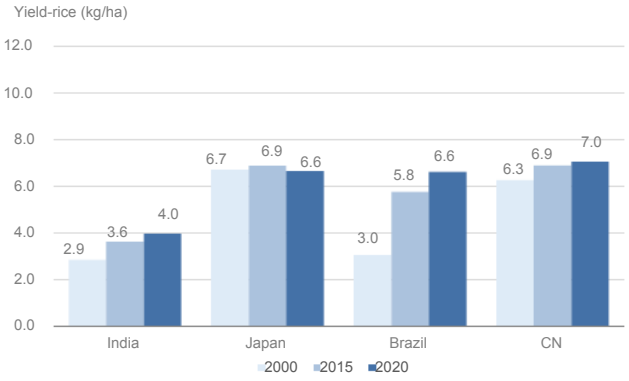
Source: USDA, ArgenBio, ISAAA, NBS, Wind, Goldman Sachs Global Investment Research

Exhibit 21: Soybean yield – China versus peers



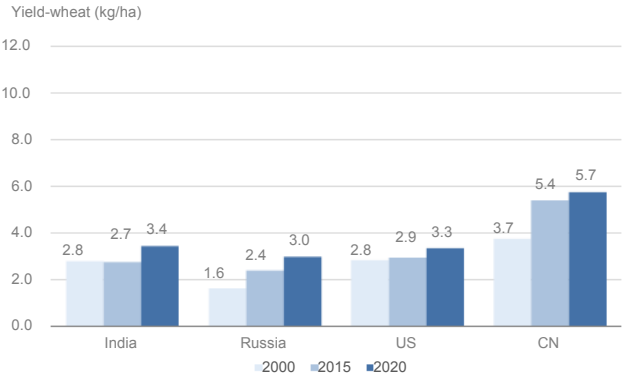
Source: USDA, ArgenBio, ISAAA, NBS, Wind, Goldman Sachs Global Investment Research

Exhibit 22: Rice yield – China versus peers



Source: USDA, ArgenBio, ISAAA, NBS, Wind, Data compiled by Goldman Sachs Global Investment Research

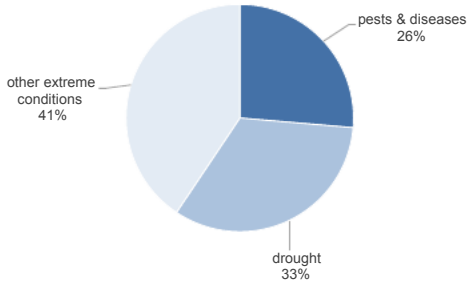
Exhibit 23: Wheat yield – China versus peers



Source: USDA, ArgenBio, ISAAA, NBS, Wind, Data compiled by Goldman Sachs Global Investment Research

We estimate the annual yield loss in corn due to pests and other diseases, including corn leaf blight and corn rust, averaged ~5% of current production in China, or 12mnt, based on reported data from the MOA. The actual loss may be higher – each year we estimate nearly 18% of the arable land has been affected by pests (with an average 10-30% impact on yield once affected), and 12% was affected by extreme weather. Among all factors, we estimate pests and drought contributed to 60% of the yield loss. Most of the 1st generation GM traits seeds are insect tolerant, with resistance to major pest types in China, such as corn borer and army worm, and thus should minimize the current yield losses from pests.

Exhibit 24: Causes of annual yield loss of major grains – China (as of 2020A)



Source: MOA, Goldman Sachs Global Investment Research

Exhibit 25: Major plant diseases and average yield losses – China (as of 2020A)

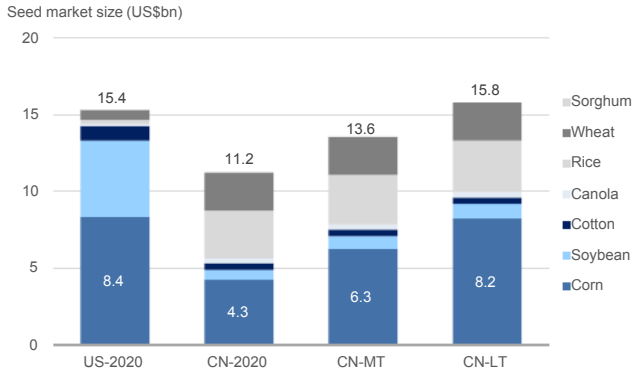
Grains	Diseases		Loss range
Corn	Corn borer	玉米螟	15-20%
	Armyworm	粘虫	10-20%
	Fall armyworm	草地贪夜蛾	10-25%
	Cotton bollworm	棉铃虫	5%
	Agrotis ipsilon	小地老虎	17%
	Corn leaf blight	玉米大小斑病	20-30%
	Southern corn rust	南方锈病	10-20%
Wheat	Fusarium head blight of wheat	赤霉病	10-20%
	Wheat stripe rust	条锈病	10-30%
	Wheat sheath blight	纹枯病	10-20%
	Wheat aphid	蚜虫	5-20%
Rice	Rice planthopper	稻飞虱	10-30%
	Rice leaf roller	稻纵卷叶螟	10-30%
	Chilo suppressalis	二化螟	5-10%
	Rice sheath blight	纹枯病	10-30%
	Rice blast	稻瘟病	10-20%
Soybean	Glufosinate	耐草铵膦	10-12%
	Glyphosate	耐草甘膦	10-12%
	Mole crickets (Underground)	蝼蛄	n.a.
	Agrotis (Underground)	地老虎	10%

Source: Company data, Goldman Sachs Global Investment Research

Bio-tech seeds penetration and the TAM outlook

We expect the Chinese seed market to potentially expand by 21% from the current of US$11bn level to reach US$14bn by 2027E, similar to the US seed market, given the increasing GMO penetration in corn and soybean, and 4-7% further commercialization in rice and wheat. We estimate the market size has the potential to reach US$16bn in the long run. On a long-term basis, we estimate improved seed quality could generate of US$7bn in value per annum for Chinese farmers.

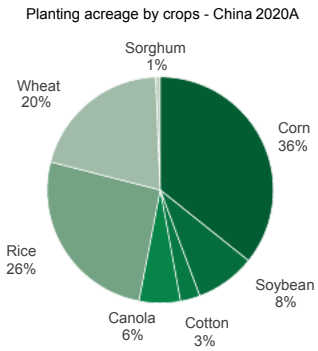
Exhibit 26: Market size of seeds – China vs peers



MT = Medium term (2027E); LT = (2030E/LT)

Source: NBS, Wind, Goldman Sachs Global Investment Research

Exhibit 27: Planting acreage by crop type – China 2020A



Source: FAO, MOA, USDA, Data compiled by Goldman Sachs Global Investment Research

Among all grains, we see the most attractive opportunity in corn seeds, given the large planting area (36% of total) of corn in China, lower penetration rate in GM seeds currently (in theory 0%), and potential early implementation of GM seeds deregulation (likely to start in the 2022-23 planting season in selected regions). We expect the GM seeds penetration for corn seeds to reach 90% by 2027E, five years post the potential introduction of 1st generation GM seeds.

For soybean, we expect the GM seeds penetration to reach 60-70% by 2028E, led by higher weed-killing herbicides tolerance and increasing yield improvement.

In addition to the major grains, we estimate the vegetable/fruit seed market at Rmb30bn in size (as of 2017A, or US$4.6bn), and potentially expanding by up to 10x in the long run, as penetration of higher quality F1 hybrid seeds that possess desired traits could be priced at 10x versus the conventional open pollinated seeds, if we benchmark GS (link).

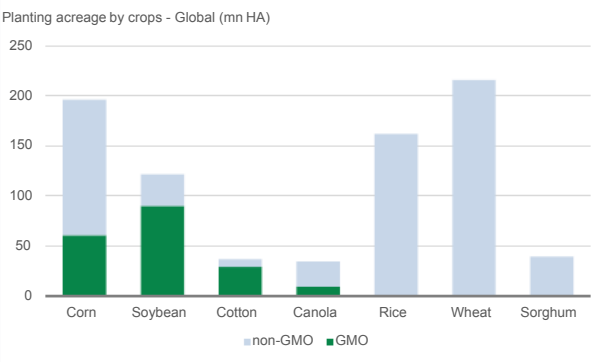
GM seeds – current, past, and future

GMO refers to a genetically modified organism. In the context of crops and seeds, the term GMO is used when an external gene from another species is imported into the organism of the crop, in an attempt to create favorable traits. For example, in GM Bt-corn and soybean, two of the most widely planted GMO crops, a bacterium called Bacillus thuringiensis, which can produce a protein that is toxic to selected insects, was introduced to the crops' genome to create the traits of insect tolerance in crops.

Today, most common GMO crops possess traits that are insect and herbicide tolerant and bring economic benefit to farmers. Next generation GMO crops can be more beneficial to consumers, e.g. the Golden Rice that bred the beta-carotene genes into rice were designed to offer people in developing countries a valuable and affordable choice in the fight against malnutrition.

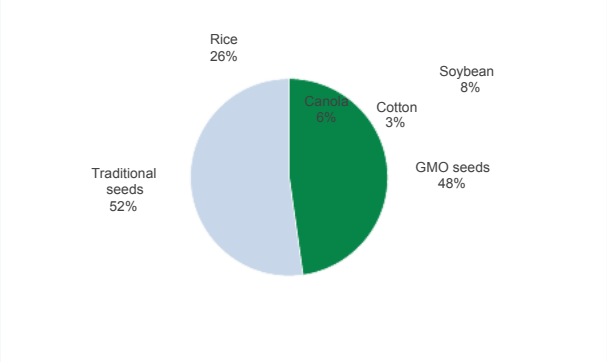
Based on information from ISAAA, GMO crops cover 31% of the global arable land for corn, 74% for soybean, 79% for cotton, and 27% for canola, as of 2020. GMO has been authorized for planting and highly adopted at 90%+ for corn, soybean, canola and cotton in most of the Americas, such as the US, Canada, Brazil and Argentina. Among Asian countries, the Philippines is the only country that has authorized GMO for most of its feed and crops, with nearly ~70% of its corn output adopting GMO. China has only authorized planting of GMO cotton and papaya in 1997 and 2006, respectively.

Exhibit 28: GMO seeds penetration – global (as of 2020A)



Source: USDA, ArgenBio, ISAAA, NBS, Wind, Goldman Sachs Global Investment Research

Exhibit 29: global seed market size – GMO vs traditional (as of 2020A)



Source: Company data, Goldman Sachs Global Investment Research

Initial period of adoption

GMO herbicide tolerant (HT) soybean was first introduced in the US and Argentina in 1996, later followed by HT-corn and Bt-corn (insect resistant). Of these, HT soybean was the most popular trait for US and Argentina farmers, and it took nearly 10 years to reach a 90% adoption rate. For GMO corn, it took nearly 15 years to become predominantly adopted by farmers, with the adoption rate accelerating after the 2000s when stacked traits became more popular. Brazil introduced GMO in 2006, yet it took just five years before market adoption reached 90%.

Upgrade in the 2000s

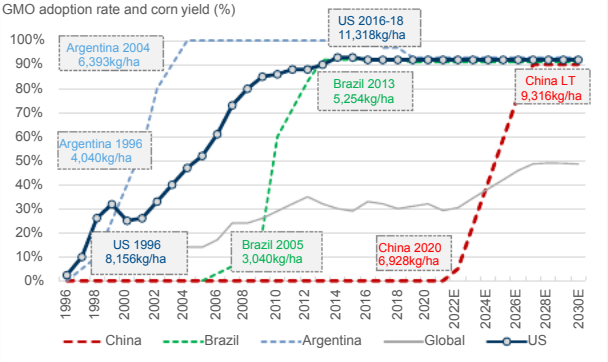
Starting from the 2000s, major seed companies in the US started to launch a series of new generation production, most designed to either counter more insects (e.g. Monsanto's YieldGard VT Rootworm, and DuPont Pioneer's Herculex RW), or improve yield performance of herbicide tolerant crops (e.g. Monsanto's

Roundup Ready 2).

Latest generation introduced new herbicide tolerance

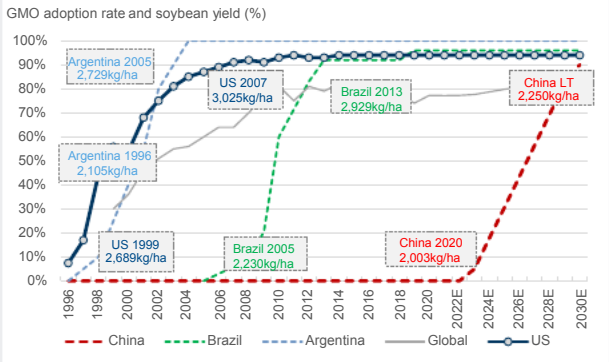
As some weeds have been reported to become tolerant to Glyphosate, potentially weakening the performance of last generation HT-seeds, companies have started to launch new generation products since 2015 that could tolerate additional herbicide chemicals beyond Glyphosate and Glufosinate. Some examples include Corteva's Enlist series which is tolerant to 2,4-D choline, and Bayer's Xtend series, which is tolerant to Dicamba.

Exhibit 30: GMO adoption rate and corn yield



Source: USDA, ArgenBio, ISAAA, Company data, Goldman Sachs Global Investment Research

Exhibit 31: GMO adoption rate and soybean yield



Source: USDA, ArgenBio, ISAAA, NBS, Wind, Goldman Sachs Global Investment Research

Supply consolidation - more significant for traits owners

We expect the bio-tech development of GM seeds to accelerate consolidation of China's seed industry, and bringing stronger pricing power along the way. We assume a higher capture ratio of 10% by seed producers as a result, versus the historical 4-6% during 2006A-2020A in China, and 11-17% during 1998A-2020A in the US.

With the economic value created from GM seeds to farms and the improved industry supply outlook, we expect 1st generation GM seeds to lead to 30-40% seed value appreciation, and potentially ~80% in the long term, which would translate to a potential seed revenue growth from Rmb0.6bn to Rmb3.3bn (or 34% CAGR) for DBN, from Rmb1.1bn to Rmb3.4bn for Denghai (or 21% CAGR), and from Rmb3.5bn to Rmb6.3bn for Longping (or 10% CAGR) during 2021A-2027E. Accordingly, our analysis suggests this would translate to earning upside of 4-16% for Dabeinong, 2-18% for Denghai, 2-18% for Longping, and 27-33% upside to valuations.

The prevailing traits advantage and economic benefits carried through seeds should enable rapid market share gains by the top seed performers, and accelerate the elimination of the long tail end of the much fragmented industry supply. Nevertheless, we expect consolidation among the bio-tech traits suppliers will be most significant, while competition among the germplasm owners will likely remain intense. While non-exclusive collaboration among the trait developers and germplasm owners should expedite the speed of GM seeds penetration, it is likely to introduce hundreds of seed producers in the GM seeds segment. On the other hand, the bio-tech traits owners, currently only three companies based on the 30 traits with bio-security approval with regional coverage (corn, soybean, rice), should rise and dominate the corn and soybean seed market in the medium term, thus are most attractive in the medium term, in our view.

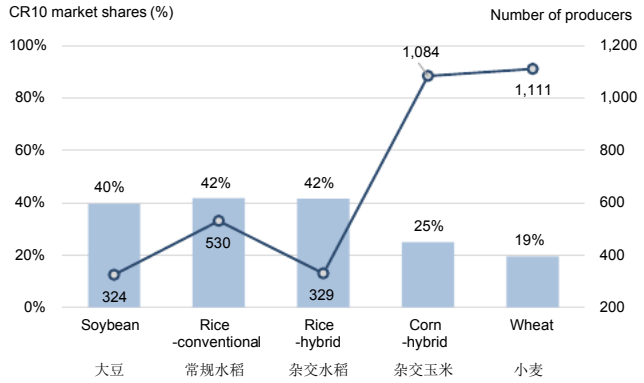
Supply consolidation

China's seed market is currently highly fragmented, with over 3,000 seed producers. Based on the MOA, the top 10 producers of each major grain account for 19-42% of the total market share, and supply the market with the other 300-1,100 seed producers. The industry structure has been stagnant for many years, due to lack of differentiation in seed quality, as well as IP enforcement.

Nevertheless, the potential introduction of bio-tech seeds could revolutionize the industry landscape. We expect the bio-tech trait owners, including DBN, Ruifeng/Longping, and Syngenta, to control the prevailing market share of the corn and soybean seed market 3-5 years post the potential commercial launch of the GM seeds. Base on the approved and pending traits and regional planting exposure, among the major trait owners, we believe DBN has the most coverage in terms of regions and traits to counter the more impactful pests. Based on the weighted average of the regional coverage and traits impact, we estimate DBN to hold the highest market share in GM traits of corn and soybean at 56-63%, followed by Longping at 29% and Syngenta at 13% for corn in the long term.

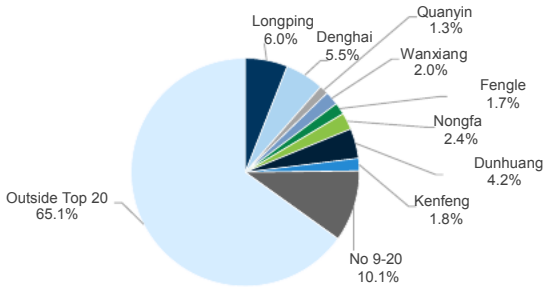
We expect local germplasm providers, who combine bio-tech traits with local varieties, to consolidate, yet, envision this being much less aggressive than for the trait companies. For example, among the over 1,000 producers in the hybrid corn market, 130 local seed companies are collaborating with DBN in the potential corn GM seeds conversion.

Exhibit 32: Supply structure – China seed industry 2020A



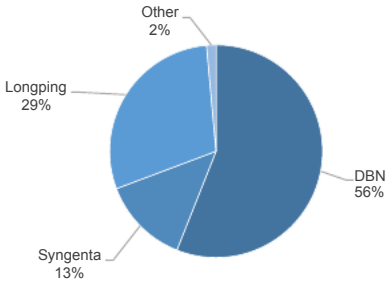
Source: MOA, Goldman Sachs Global Investment Research

Exhibit 33: Corn seed market share – China 2010/21A



Source: MOA, Company data, Goldman Sachs Global Investment Research

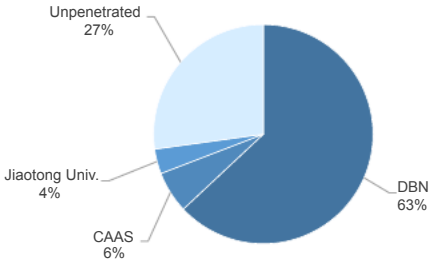
Exhibit 34: Market share of corn GM traits – long-term (2030E/LT)



*estimated based on weighted average of traits and regional approvals

Source: MOA, Company data, Goldman Sachs Global Investment Research

Exhibit 35: Market share of soybean GM traits – long-term (2030E/LT)



*estimated based on weighted average of traits and regional approvals

Source: MOA, Company data, Goldman Sachs Global Investment Research

Exhibit 36: Major GM traits and regional approvals – corn and soybean, China

Yield loss	Causes		Northern Company	北方春玉米区 Traits approved	Central north Company	黄淮海玉米区 Traits approved	Southwest Company	西南玉米区 Traits approved	Southern Company	南方玉米区 Traits approved	Northwest Company	西北玉米区 Traits approved
Corn												
15-20%	玉米螟	Corn borer	DBN Longping Syngenta	DBN9936 Ruifeng 125 Bt11×GA21	DBN Longping	DBN9936 Ruifeng 125	DBN DBN	DBN9936 DBN3601T	DBN Longping Syngenta China Seed	DBN9936 Ruifeng 8 Bt11×MIR162×GA21 ND207	DBN Longping Syngenta	DB9936 Ruifeng 125 Bt11×MIR162×GA21
10-20%	粘虫	Armyworm	DBN Longping	DBN9936 Ruifeng 125	DBN Longping	DBN9936 Ruifeng 125	DBN DBN	DBN9936 DBN3601T	DBN Longping Syngenta China Seed	DBN9936 Ruifeng 8 Bt11×MIR162×GA21 ND207	DBN Longping Syngenta	DB9936 Ruifeng 125 Bt11×MIR162×GA21
10-25%	草地贪夜蛾	Fall armyworm					DBN	DBN3601T	Syngenta	Bt11×MIR162×GA21	Syngenta	Bt11×MIR162×GA21
5%	棉铃虫	Cotton bollworm	DBN DBN Syngenta Longping	DBN9936 DBN9501 Bt11×GA21 Ruifeng 125	DBN Longping	DB9936 Ruifeng 125	DBN DBN	DBN9936 DBN3601T	DBN Longping Syngenta China Seed	DB9936 Ruifeng 8 Bt11×MIR162×GA21 ND207	DBN Longping Syngenta	DB9936 Ruifeng 125 Bt11×MIR162×GA21
17%	小地老虎	Agrotis ipsilon	DBN	DBN9501			DBN	DBN3601T	Syngenta	Bt11×MIR162×GA21	Syngenta	Bt11×MIR162×GA21
2.0%	耐草铵膦	Glufosinate	DBN DBN DBN Syngenta Syngenta	DBN9858 DBN9936 DBN9501 Bt11×GA21 GA21	DBN DBN	DBN9858 DBN9936	DBN DBN DBN	DBN9858 DBN9936 DBN3601T	DBN DBN Syngenta	DBN9858 DBN9936 Bt11×MIR162×GA21	DBN DBN	DBN9858 DBN9936
2.0%	耐草甘膦	Glyphosate	DBN DBN DBN Syngenta Syngenta	DBN9858 DBN9936 DBN9501 Bt11×GA21 GA21	DBN DBN Longping	DBN9858 DBN9936 Ruifeng 125	DBN DBN DBN	DBN9858 DBN9936 DBN3601T	DBN DBN Syngenta Longping	DBN9858 DBN9936 Bt11×MIR162×GA21 nCX-1 (Refuge)	DBN DBN Longping	DBN9858 DBN9936 Ruifeng 125
Soybean												
5.0%	耐草铵膦	Glufosinate	DBN	DBN9004								
5.0%	耐草甘膦	Glyphosate	DBN	DBN9004	CAAS	ZH 6106			SHJT Univ.	SHZD3201		

Source: MOA, Company data, Data compiled by Goldman Sachs Global Investment Research

Exhibit 37: Approved bio-security GM traits as of April, 2022- China

No	Year	Crop	Applicant - Chinese	Applicant - English	Approved bio-security certificates 生产应用的安全证书	Traits
1	2018	papaya	中国热带农业科学院热带生物技术研究所	Institute of Tropical Biosci and Biotech	YK1601 在华南适宜生态区	转 PRSV-YK CP 基因抗病番木瓜
2	2019	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9936 在北方春玉米区	转 cry1Ab 和 epsps 基因抗虫耐除草剂玉米
3	2019	corn	杭州瑞丰生物科技有限公司/浙江大学	Hangzhou Ruifeng Bioscience/Zhejiang U	瑞丰 125 在北方春玉米区	转 cry1Ab/cry2Aj 和 g10evo-epsps 基因抗虫耐除草剂玉米
4	2019	soybean	上海交通大学	Shanghai Jiao Tong University (SJTU)	SHZD3201 在南方大豆区	转 g10evo-epsps 基因耐除草剂大豆
5	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9858 在黄淮海夏玉米区	转 epsps 和 pat 基因耐除草剂玉米
6	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9858 在南方玉米区	转 epsps 和 pat 基因耐除草剂玉米
7	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9858 在西南玉米区	转 epsps 和 pat 基因耐除草剂玉米
8	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9858 在西北玉米区	转 epsps 和 pat 基因耐除草剂玉米
9	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9936 在黄淮海夏玉米区	转 cry1Ab 和 epsps 基因抗虫耐除草剂玉米
10	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9936 在南方玉米区	转 cry1Ab 和 epsps 基因抗虫耐除草剂玉米
11	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9936 在西南玉米区	转 cry1Ab 和 epsps 基因抗虫耐除草剂玉米
12	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9936 在西北玉米区	转 cry1Ab 和 epsps 基因抗虫耐除草剂玉米
13	2020	papaya	华南农业大学	South China Agricultural University (SCAU)	华农 1 号在华南地区	转番木瓜环斑病毒复制酶基因的番木瓜
14	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9501 在北方春玉米区	转 vip3Aa19 和 pat 基因抗虫耐除草剂玉米
15	2020	soybean	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9004 在北方春大豆区	转 epsps 和 pat 基因耐除草剂大豆
16	2020	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN9858 在北方春玉米区	转 epsps 和 pat 基因耐除草剂玉米
17	2020	soybean	中国农业科学院作物科学研究所	Institute of Crop Science of CAAS	中黄 6106在黄淮海夏大豆区	转g2-epsps 和gat 基因耐除草剂大豆
18	2021	rice	华中农业大学	Huazhong Agricultural University (HZAU)	Bt汕优63 在湖北省	转 cry1Ab/cry1Ac基因抗虫水稻
19	2021	rice	华中农业大学	Huazhong Agricultural University (HZAU)	华恢1 号在湖北省	转cry1Ab/cry1Ac 基因抗虫水稻
20	2021	corn	杭州瑞丰生物科技有限公司	Hangzhou Ruifeng Bioscience Co.	瑞丰 125 在黄淮海夏玉米区	转 cry1Ab/cry2Aj 和 g10evo-epsps 基因抗虫耐除草剂玉米
21	2021	corn	杭州瑞丰生物科技有限公司	Hangzhou Ruifeng Bioscience Co.	瑞丰 125 在西北玉米区	转 cry1Ab/cry2Aj 和 g10evo-epsps 基因抗虫耐除草剂玉米
22	2021	soybean	中国农业科学院作物科学研究所	Institute of Crop Science of CAAS	中黄 6106在北方春大豆	转 g2-epsps 和 gat 基因耐除草剂大豆
23	2021	corn	中国林木种子集团有限公司 / 中国农业大学	China National Tree SEED Group / China Agricultural University (CAU)	ND207在北方春玉米区	转mcry1Ab 和 mcry2Ab 基因抗虫玉米
24	2021	corn	中国林木种子集团有限公司 / 中国农业大学	China National Tree SEED Group / China Agricultural University (CAU)	ND207在黄淮海夏玉米区	转mcry1Ab 和 mcry2Ab 基因抗虫玉米
25	2021	corn	杭州瑞丰生物科技有限公司	Hangzhou Ruifeng Bioscience Co.	瑞丰8在南方玉米区	转cry1Ab 和cry2Ab 基因抗虫玉米
26	2021	corn	北京大北农生物技术有限公司	Beijing Dabeinong Biotechnology Co.	DBN3601T 在西南玉米区	聚合 cry1Ab、epsps，vip3Aa19、pat 基因的抗虫耐除草剂玉米
27	2022	corn	杭州瑞丰生物科技有限公司	Hangzhou Ruifeng Bioscience Co.	nCX-1 在南方玉米区	转 CdP450 和 cp4epsps 基因耐除草剂玉米
28	2022	corn	中国种子集团有限公司	China National SEED Group	Bt11×GA21 在北方春玉米区	聚合 cry1Ab、pat，mepsps 基因抗虫耐除草剂玉米
29	2022	corn	中国种子集团有限公司	China National SEED Group	Bt11×MIR162×GA21 在南方及西南玉米区	聚合 cry1Ab 、pat ， vip3Aa20 ， mepsps 基因抗虫耐除草剂玉米
30	2022	corn	中国种子集团有限公司	China National SEED Group	GA21 在北方春玉米区	转 mepsps 基因耐除草剂玉米

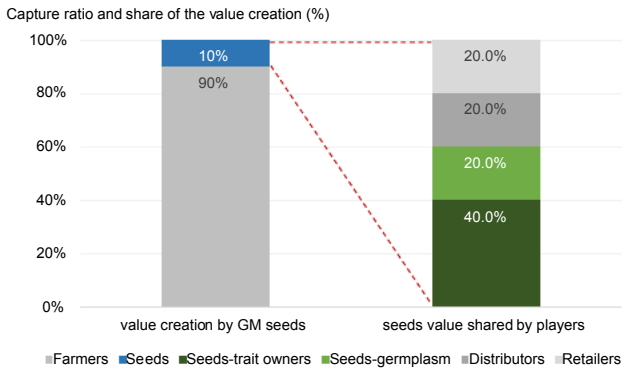
Source: MOA, Data compiled by Goldman Sachs Global Investment Research

Capture ratio and profit split – in favor of traits owner

Based on preliminary feedback from producers, the capture ratio could be 10-15% of the incremental benefit in early phase of GM seeds in China, nearly double versus the average of the past years. Among all the players, we expect bio-tech owners to have an upper hand, likely taking 40% of the total profit, with the remaining 60% to be shared among germplasm owners, distributors and retailers. Preliminary feedback from producers suggest nearly 40% shares to retailers and distributors in China.

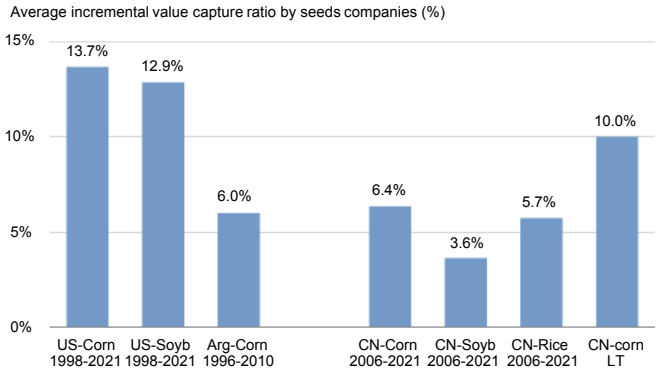
Given the numbers of producers, there is risk of lower-capture ratio at the germplasm owner and distributor levels in our view. During the GM adoption period, Argentina only had 6% capture ratio, less than half of that in the US, partly due to US seed companies never bringing their germplasm in the US to these markets, combined with weak IP enforcement (the local law allowed farmers to use seeds generated from their harvests freely in later plantings, unlike their counterparts in the US (link) where trait owners like Monsanto charged local farmers based on contracted royalty rate annually for licensing out GMO traits).

Exhibit 38: GM seeds valuation created



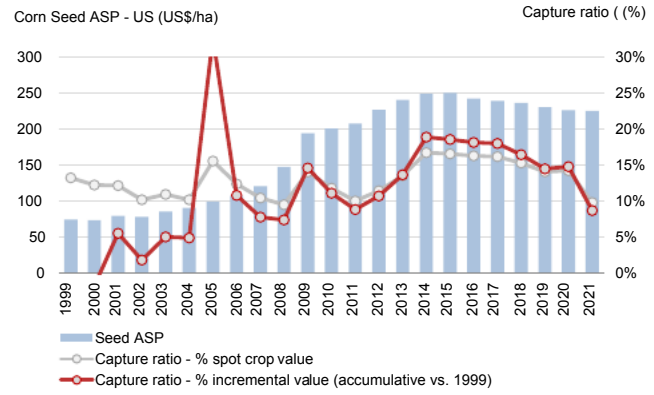
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 39: Captue ratio of seeds value – China vs others



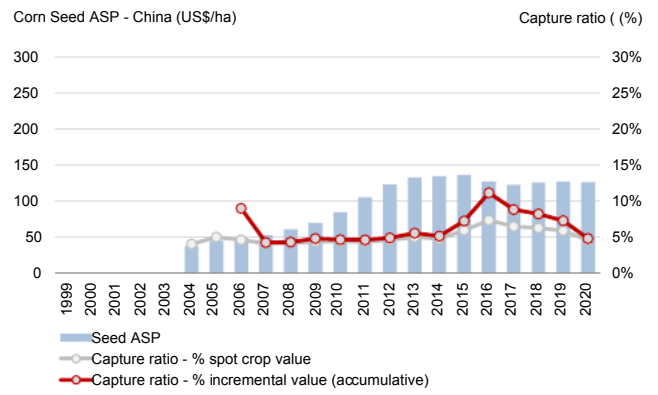
Source: USDA, FAO, MOA, Goldman Sachs Global Investment Research

Exhibit 40: Seeds value and capture ratio – US corn



Source: USDA, FAO, Goldman Sachs Global Investment Research

Exhibit 41: Seeds value and capture ratio – China

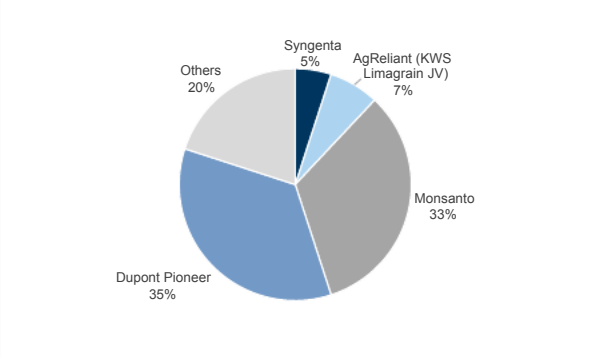


Source: MOA, Goldman Sachs Global Investment Research

How traits value was captured in the US GM market

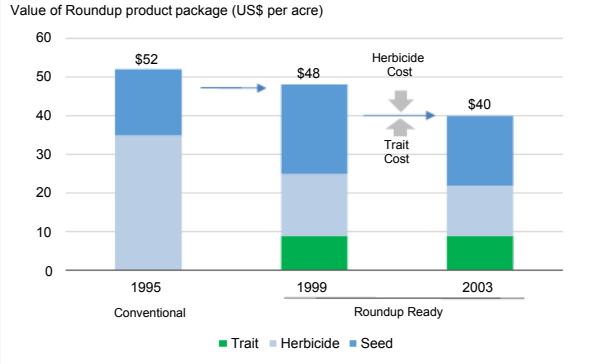
The US seed market was highly concentrated which maximized the value capture for seeds producers. Among all, traits owners held the strongest power. One example is Monsanto's Roundup Ready (RR), the first ever GMO seed product introduced in 1995 in the US market which was tolerant to herbicide. Before RR was introduced, farmers spent ~US$17/acre (US$42/hectare) on seeds, based on Monsanto's presentation. This spending nearly doubled in the RR package, or ~US$32/acre (US$69/hectare) for seeds and GMO traits coded in the seeds. The cost of seed then normalized to ~US$27/acre post GMO reaching 90%+ penetration in the US, which is still 60% above the pre-GMO period.

Exhibit 42: Corn seed market share – US 2016A



Source: CITIC Agri Fund, Company data, Data compiled by Goldman Sachs Global Investment Research

Exhibit 43: How seeds value changes with improving quality
Value of trait increases, despite lower seed costs, in Monsanto's HT Roundup

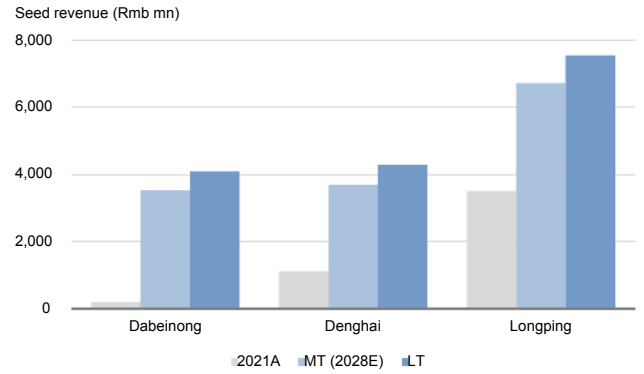


Source: Company data, Data compiled by Goldman Sachs Global Investment Research

Revenue growth implication for top seed players

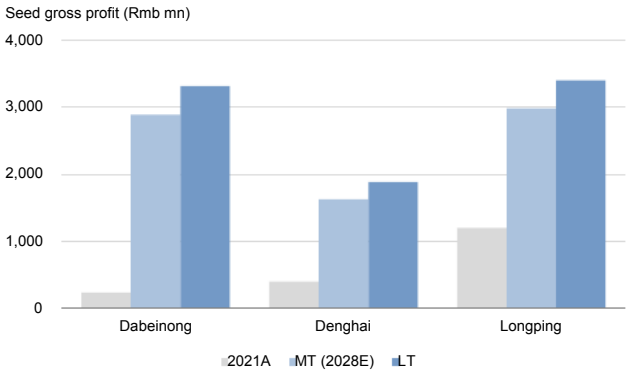
With the economic values created from seeds to farms and improved industry supply outlook, we expect 1st generation GM seeds to lead to 30-40% of seed value appreciation, and potential ~80% in the long-run, which would translate to a potential seed revenue growth from Rmb0.6bn to Rmb3.3bn (or 34% CAGR) for DBN, from Rmb1.1bn to Rmb3.4bn for Denghai (or 21% CAGR), and from Rmb3.5bn to Rmb6.3bn for Longping (or 10% CAGR) during 2021A-2027E. This would translate to earning upside of 4-16% for Dabeinong, 2-18% for Denghai, 2-18% for Longping, and 27-33% upside to valuations. In addition, we note the overall R&D spending for top Chinese producers are moving up in absolute value or as % of revenue - with positive trend in DBN, and Denghai, yet declining for Longping partly due to less R&D expenditure capitalized during 2021A.

Exhibit 44: Seed revenue by major producers



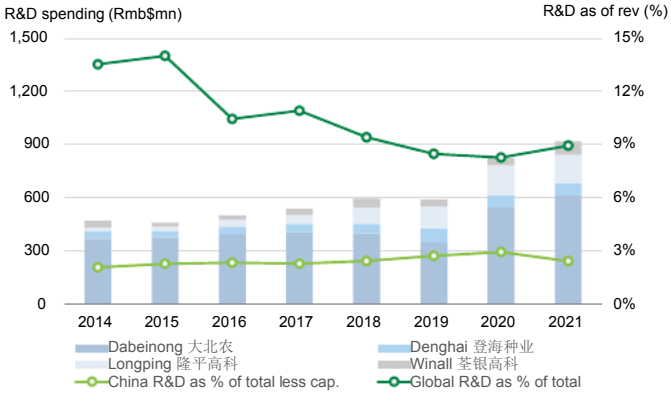
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 45: Seed gross profit by major producers



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 46: R&D expenditure for seed breeders – China vs. global



Source: Company data, Thomson Reuters, Bloomberg, Goldman Sachs Global Investment Research

Policy support paving the way; all eyes on IP improvement

Regulations and policies are paving the way for the 1st generation of GM seeds. In addition to the 30 bio-security traits approved since 2019, the Chinese government has issued a numbers of new/revised policies and regulations, with the aim of revitalizing the seed industry. Specially on GM seeds, recent policies set regulations from traits testing standard and safety measure, to the method of commercial registration of GMO seeds. The newly published agricultural variety approval standard has also shortened the production testing period from 2 years to 1 year if GMO traits are merged into approved recipient varieties("已审定受体"). Yet, the development of GM commercial seeds remains a lengthy process, with full trait development typically taking 6-8 years, 3 years for incorporating to germplasm, and 2 years for GM seeds production, based on producers' feedback.

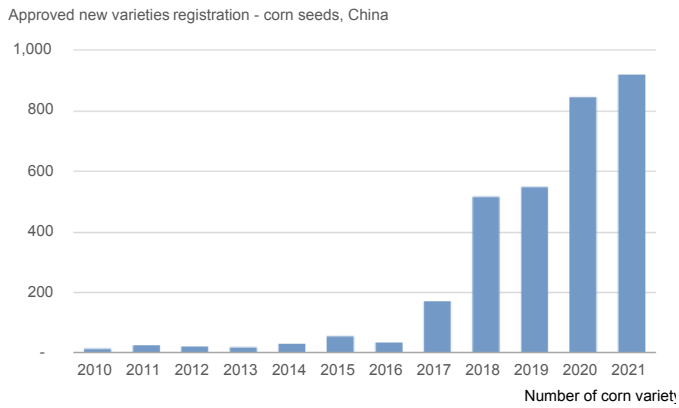
Trial seeds production is currently being done in 60k mu area for selected producers, and is currently operated under the inspection of MOA, with the first batch of GMO seeds expected to roll out to the market by Jan next year.

The nature of seed breeding requires upfront commitment in terms of both investment and time, thus making proper IP ultimately critical for the sustainability of ongoing innovation and seed development. We see signs of improvement, mostly on regulations including higher penalty in IP infringement, and likely tighter control in future trait approvals. We summarize the existing punitive measures for IP infringement below, after the amendment of Seed Law on Dec, 2021.

- Increased penalty in infringement of new variety with penalty cap raised from three times to five times, and absolute penalty cap raised from Rmb3mn to Rmb5mn.
- For sales of forged and interior seeds, penalty amount has been raised to Rmb20k-200k and Rmb10k-100k respectively if transaction value is less than Rmb 20k; if transaction value is greater than Rmb 20k, the penalty would cap at 10-20 times of the transaction value for fake seeds, and 5-10 times for interior seeds.
- MoA also set forth a circular on Feb 2022, encouraging domestic seed providers to invest in original biological innovation with support of high-level research activities. According to the circular, newly developed GMO traits henceforth should have material difference/strength compared to traits with GMO safety approvals already.

One key indication in terms of IP protection in our view would be the trend of new varieties' registration, which has expedited since 2014 due to the roll-out of "green channel" scheme, which has shortened the approval time needed for qualified seed breeders and therefore increased the variety registration number since then. However, we see a potential slowdown of new registration going forward, given more stringent measures should apply after the introduction of the new seed law, which encourages differentiation on new variety granted and original research work.

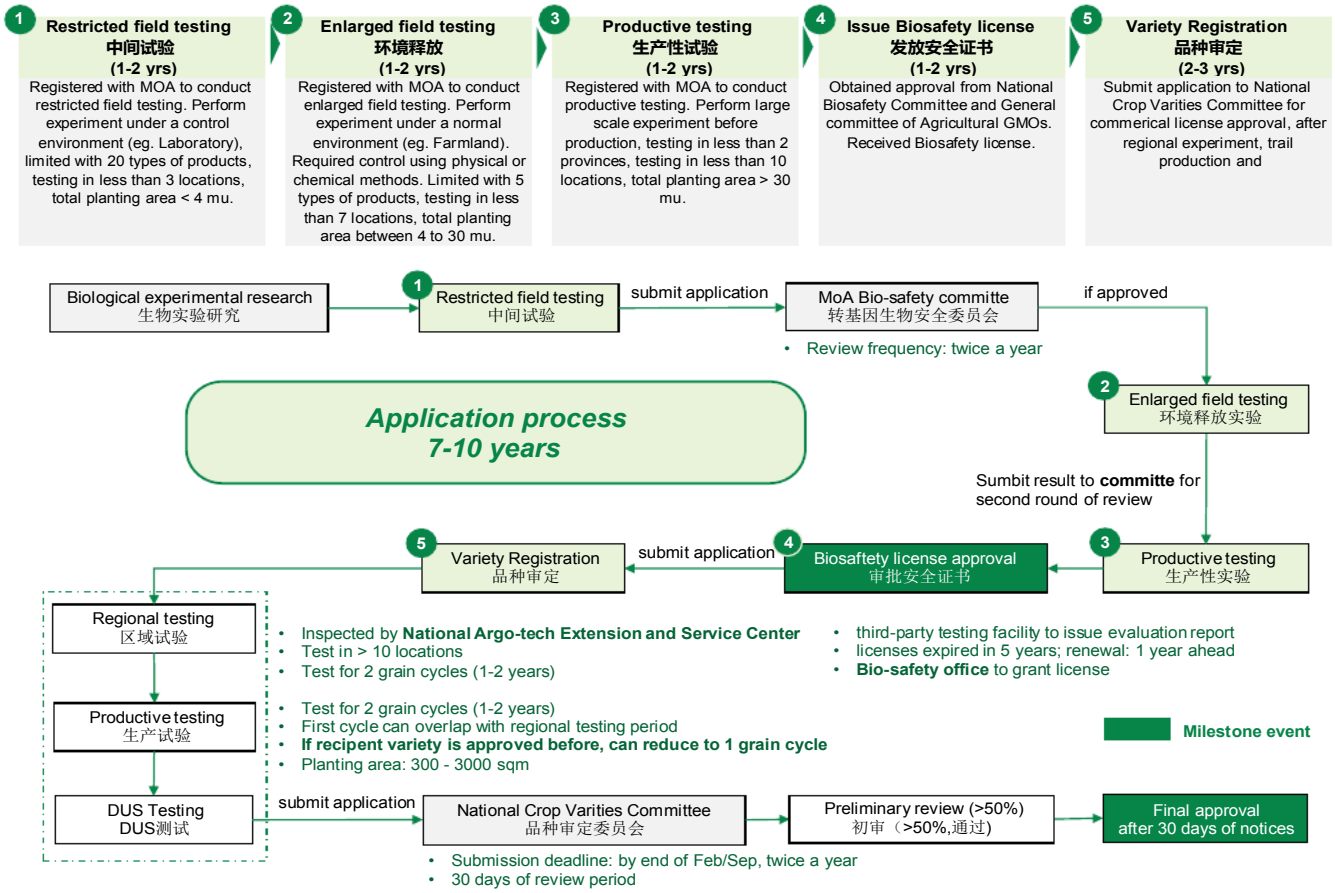
Exhibit 47: Approved new varieties registration – corn seeds



Source: MOA, Goldman Sachs Global Investment Research

On the other hand, there are self IP protections by nature for selected crops: Typically, seeds of self-pollinated crops such as wheat, cotton could be saved for future plantation, with most of the vigor retained. On the other hand, open-pollinated crops such as corn could lose vigor in its offspring - a key reason behind more commercial success of GM corn seeds.

Exhibit 48: GMO regulatory approval process in China



Source: MOA, Compiled by Goldman Sachs Global Investment Research

Exhibit 49: Recent government policies on seeds industry development – China

Time	Institution	Event	Description/Impact
2015			
Nov-15	NPC	Amendment of Seed Law 《中华人民共和国种子法》修订	● Simplified variety approval system; ● Excluded academic institutions from engaging in commercial breeding program ● Clarified and formalized IP protection rules in seed area.
2018			
Nov-18	MOA, Supreme Court, CASS	Published court cases 《农作物种子质量年专项行动实施方案》	● Started annual review of 10 most impactful court cases of plant variety protection ● Foreign brands successfully won seed IP cases in China
2020			
Jun-20	State Council	Published Hainan Free Port Framework《中国(海南)自由贸易试验区发展报告(2019)》	● Planned to develop Hainan Free Port as a transition hub of global germplasm ● Delegated larger legislative power to Hainan Local government
Dec-20	Politburo	Central Economic Work Conference 中央经济工作会议	● Tackling the technical shortcomings in seed resources
2021			
Jan-21	MOA	Released work plan of GMO regulation《农业转基因生物监管工作方案》	● Targeted 100% inspection of GMO in testing, breeding and planting field
Feb-21	MOA	Reported illegal GMO seed production cases查处非法转基因案件	● MOA reported four recent cases of illegal GMO seed production
Feb-21	MOA	Document to regulate GMO material transfer《关于鼓励农业转基因生物原始创新和规范生物材料转移转让转育的通知》	● Reiterated encouragement of GMO related innovation ● Formalized rules to regulate transfer of GMO related biological materials
Mar-21	MOA	Minister speech	● MOA minister emphasized IP production in seed industry and plans to crack down copycat activities
Mar-21	Supreme Court	Deputy divisional chief judge speech	● Deputy divisional chief judge of supreme court spoke on National Seed Conference to encourage Hainan to explore IP regulation and protection system.
Mar-21	Hainan IP Bureau	Local chief speech	● Hainan is exploring to set higher standard of Seed IP production such as implementing UPOV 1991
Mar-21	Supreme Court	Soliciting opinions on Judicial interpretation	● Supreme Court is soliciting opinions on judicial interpretation regarding IP protection details in the Seed Law
Mar-21	MOA	Launched spring market inspection program春季农作物种子市场检查	● Targeted program during spring planting season to crack down copycat and fake seed products.
Apr-21	MOA	Promote further legislative amendment	● MOA seeking to promote further legislative amendment of Seed Law and Plant New Varieties Protection Regulations
Jul-21	Supreme Court, MOA	Launched seed IP protective judicial interpretation《关于审理侵害植物新品种权纠纷案件具体应用法律问题的若干规定》	● Supreme Court announced more penalties for IP infringement in seed industry, and created blacklist for IP infringement entities
Jul-21	Politburo Deepening Reforms Commission	Launched of Action Plan on vitalizing seed industry《种业振兴行动方案》	● President and commission stressed efforts to foster the new development paradigm, promote the vitalization of the seed industry and advance ecological and environmental protection as well as sustainable development of the Qinghai-Tibet Plateau
Dec-21	Standing Committee of the National People's Congress	Seed Law amendment draft was approved by Standing Committee of the National People's Congress全国人大常委会通过《种子法》修正草案，并于2022年3月1日开始施行。	● The amendment to Seed Law was approved by Standing Committee of the National People's Congress, China's top legislature, in December, aiming to improve protections for new plant varieties and encourage breeding innovation,effective on Mar, 2022.
2022			
Jan-22	MOA	Amendment of Measures for the Approval of Key Crop Varieties 《主要农作物品种审定办法》修订	● Measures for the Approval of Key Crop Varieties are revised to shorten the experiment time for approved GMO
Jan-22	MOA	Amendment of Regulations on Administration of Agricultural GMO Safety 《农业转基因生物安全评价管理方法》修订	● Regulations on Administration of Agricultural GMO Safety are revised to encourage the establishment of customized experiment bases for GMO
Jan-22	MOA	Amendment of Measures for the Administration of the Production and Business License of Crop Seeds 《农作物种子生产经营许可管理办法》修订	● Measures for the Administration of the Production and Business License of Crop Seeds are revised to enhance the administration of safety, production and business license
Jan-22	MOA	Amendment of Naming of Agricultural Plant Varieties 《农业植物品种命名规定》修订	● Naming of Agricultural Plant Varieties revised by MOA, enhancing the protection of recipient organism owner
Feb-22	MOA	MOA circular to encourage the innovation of genetically modified organism and regulating the transfer of biological materials. 《农业农村部办公厅关于鼓励农业转基因生物原始创新和规范生物材料转移转让转育的通知》	● Newly developed GMO traits should have biological differences compared to old derived ones.
Jun-22	MOA	Established National GMO Soybean Approval Standard (Trial) and National GMO Corn Approval Standard (Trial) 制定《国家级转基因大豆品种审定标准（试行）》和《国家级转基因玉米品种审定标准（试行）》	● Established National GMO Soybean Approval Standard (Trial) and National GMO Corn Approval Standard (Trial)

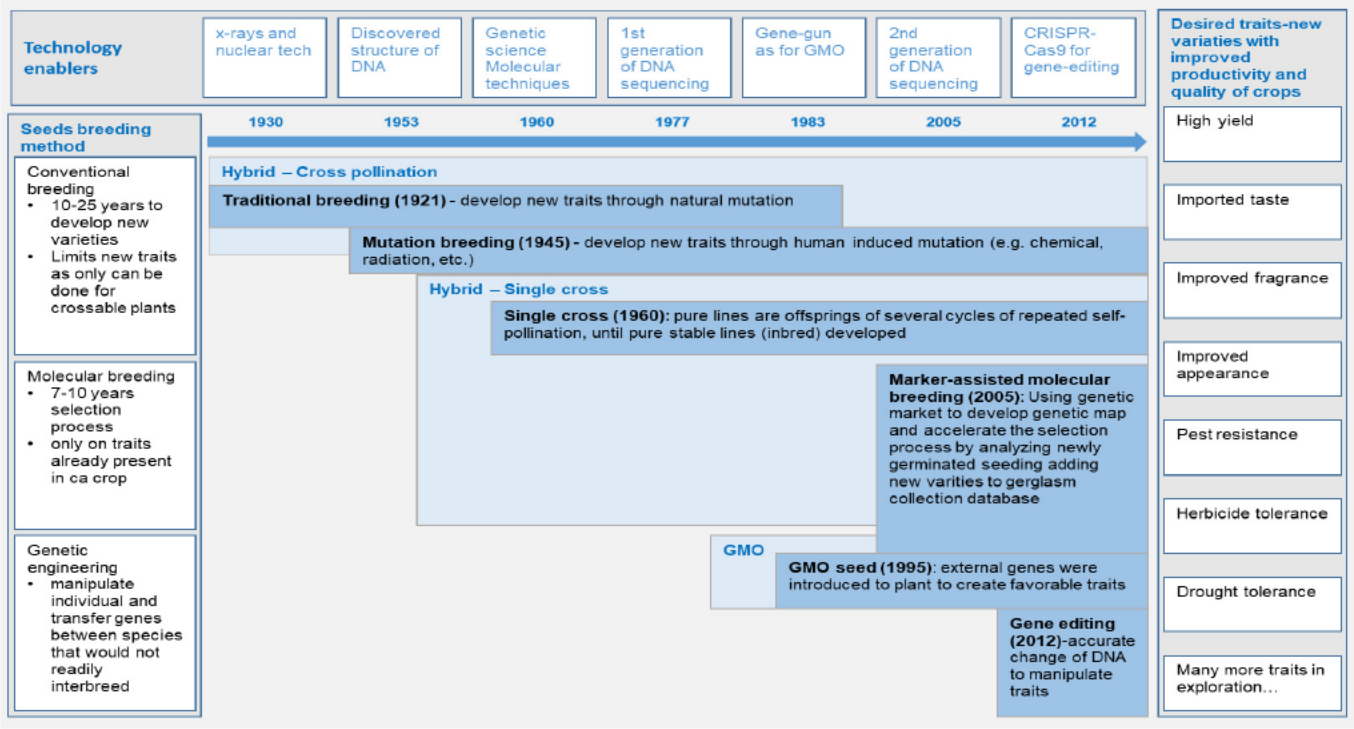
Source: MOA, Compiled by Goldman Sachs Global Investment Research

Appendix: Seed technologies

Seed breeding is a tradition, a journey of thousands of years in search of new traits in plants. It is about generating and selecting variations, and stabilizing the vigor with desired traits. The revolution of seed breeding technologies include the development of hybrid crops in the 1930s in the US. Since the 1990s, more advanced seed breeding technologies, including genetic engineering or editing, and molecular breeding have revolutionized trait development. Over the same period, the unprecedented fall in cost (by a million times) and surge in speed (by thousands of times) of gene sequencing makes marker-assisted molecular breeding a more powerful tool than ever, in developing new traits in seed breeding. With the cost of developing new traits coming off from nearly US$9.6bn in 2005, to US$130-260mn in 2008-2012, and US$5-15mn in recent years, we expect higher predictability, precision, and acceleration in the development of new traits.

Yet, there are still gaps in connecting advanced technology to trait design and execution of field crops – aggregating data, germplasm, more complete mapping of genotype versus phenotypes, etc.

Exhibit 50: History of seed breeding technology



Source: USDA, Compiled by Goldman Sachs Global Investment Research

From seeds to traits – the basics

Plant seed contains all genetic information of the plant, with traits (or phenotype, characteristics of crop) encoded. Seed therefore is a genetic system, to deliver desired plant traits to agriculture products. A typical high quality seed is a result of superior plant breeding by crossing varieties and selection of desired traits, as well as optimization of vigor that sustains at various planting environments.

Examples of enhancing or changing traits through seeds can be achieved through conventional hybrid breeding, or through modern gene-editing tools such as CRISPR-Cas9 so as to optimize the gene of plants seeds and creating traits that could service different requirements and preferences of end agriculture products. Examples of desired plant traits are: Higher yield in major crops such as rice, corn and wheat, greater resistance to diseases, insects (such as European corn boars, fall armyworm, and canker in citrus) and herbicide (such as Glyphosate and Glufosinate), enhanced taste of flavor, larger vegetative size in soybean, change in fragrance or color, specific taste and nutrition content.

Exhibit 51: Examples of gene edited or modified agriculture product

Plants		Gene-operation	Traits realized
	Rice	The team of Ying Wang from Syngenta Bio-tech China deleted fragments of the dense and erect panicle1 (DEP1) gene in the Indica rice line IR58025B.	Higher yield, shorter plant height
	Soybean	Researchers from the Chinese Academy of Agricultural Sciences led by Yupeng Cai induced mutations on GmFT2a, an integrator in the photoperiod flowering pathway of soybean.	Increased vegetative size
	Watermelon	Researchers from Beijing Key Laboratory of Vegetable Germplasm Improvement, led by Shouwei Tian to target ClPDS, the phytoene desaturase in watermelon.	Albino phenotype
	Citrus	Researchers from the Chinese Academy of Agricultural Sciences and National Center for Citrus Variety Improvement and Southwest University targeted the promoter of the CsLOB1 gene in citrus, which promotes canker development.	Resistance to citrus canker
	Tomato	Cold Spring Harbor Laboratory, together with various research institutions, used CRISPR-Cas9 to generate mutations in the flowering suppressor SELF-PRUNING5G (SP5G) in tomato to manipulate photoperiod response.	Enhanced growth
	Corn	Traits of colour of gene edited corn is in darker orange due to its higher content of beta-carotene (Alliance for Science Cornell)	Taste change
	Corn	GMO seed (RHS) provides better weed control than conventional seed (LHS)（Genetic Literacy Project)	Weed tolerent

Source: ISAAA, Alliance for Science Cornell, Data compiled by Goldman Sachs Global Investment Research

Basic plant genetics

Cells are the basic units of any life, including plants. Every plant cell, including the cell in a plant seed's embryo, stores full genetic information and could be grown into a full plant given a suitable environment. Such information is stored in the structure of DNA, or more specifically, the sequence of base pairs, composed of pairing of four different adenine (i.e. adenine (A), cytosine (C), guanine (G), and thymine (T)). A single molecule, together with some proteins, entangles into thread-like structures, that become chromosomes, where genetic information is encoded.

According to US National Center for bio-technology Information (NCBI), humans have 23 pairs of chromosomes and 3.1bn base pairs of DNA. There are 10 pairs of chromosomes and 2.3-2.7 billion base pairs of nucleobases for corn, 20 pairs of chromosomes and 1.1 billion base pairs nucleobases for soybean, 21 pairs of chromosomes and 17 billion base pairs nucleobases for wheat, 28 pairs of chromosomes and 805 million base pairs nucleobases for strawberry.

A typical corn seed is composed of endosperm (where nutrition is stored), embyro (where new plant can be developed), and seed coat. The actual characteristic of a plant after fully growing, is called phenotype, or trait e.g.short, yellow fruit or red fruit etc. The focus of bio-technologies is basically finding the correlation between such gene sequences and traits, to incorporate them into inbred seeds, thus agriculture products at the end. Typically, seeds of self-pollinated crops such as wheat, cotton could be saved for future plantation, with most of the vigor retained. On the other hand, open-pollinated crops such as corn could lose vigor in its offspring.

Gene: Gene is a basic unit of heredity and a sequence of nucleotides in DNA or RNA that encodes the synthesis of a gene product, either RNA or protein.

DNA: Deoxyribonucleic acid – Genetic code that is organised into structures

Base pairs: Base pair is a fundamental unit of double-stranded nucleic acids consisting of two nucleobases bound to each other by hydrogen bonds.

Endogenous genes: Native genes within an organism's genome

Gene expression: The generation of functional gene products from DNA/genes

Genetic sequence: Typically a structure comprising DNA organised into a gene or genes

Genetic sequencing: Process of determining the nucleic acid sequence – the order of nucleotides in DNA.

Genome: Sum of the total genetic material within a cell

Genotype: Genotype is the genetic endowment of the individual

Hybrid: Progeny generated by crossing two differentinbred lines

Inbred: A genetically pure line, homogenous at all or most genetic types.

Introgression: The utilisation of conventional breeding methods to incorporate a genetic event into a commercial crop variety or inbred line

Phenotype (表型): Phenotype is the constellation of observable traits

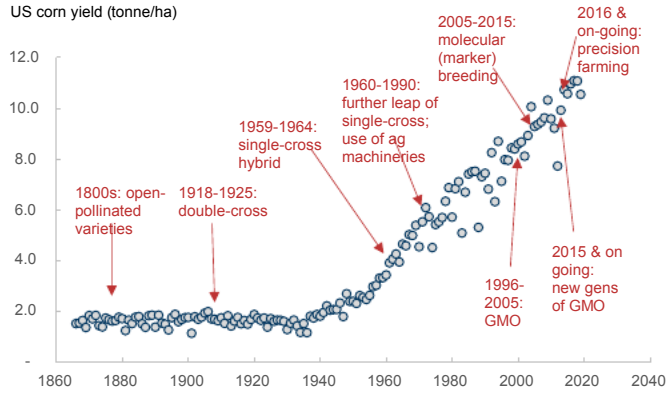
Trait: A distinguishing characteristic or quality conveyed by a gene sequence

Transgene: A gene introduced into a species from itself or from another organism by bio-technological processes

Core seed breeding technologies

In a traditional breeding process, farmers or breeders cross-breed large amount of plants in field or wild life and screen for some naturally occurring mutation of desired traits. Hybridization, a more systematic approach, was developed to bring more predictability and speed in the selection process. Since 1990s, with the help of genetic science, advanced bio-technologies and computer science, seed breeding has become more powerful in terms of predictability and precision. The evolution of the seed breeding technology, combined with machinery and precision farming, has been well reflected in the case of yield enhancement of US corn industry over the past century – a period where corn yield increased by nearly five times.

Exhibit 52: History of US corn yield evolves with the development of seed breeding technologies



Source: USDA, Goldman Sachs Global Investment Research

Single cross hybrid breeding: Single-cross breeding technology started in 1960s and has been a major milestone in plant breeding. The technology crosses two pure lines with complimentary traits (developed through 6-7 cycles from existing germplasm), to form F1 (first filial generation) hybrid, which possesses hybrid vigor over parents.

Molecular breeding (marker-assisted selection or MAS): MAS started in 2005, and has now become a routine breeding approach for many crops. The rapid advancement of gene sequencing is also making MAS more powerful than ever in trait screening and predictive breeding. By identifying a short (length of a few thousand base pairs) but unique segment of DNA sequence near the full DNA chain that encodes trait, researchers would be able to predict if the trait has been included in the plant from a new germinated seed, before the plant grows fully. MAS has revolutionized breeding by cutting time of new variety development time to 7-10 years, or even 2-3 years, from 10-25 years. To achieve this, besides conducting genotyping, correlations between genotype and phenotype also need to be mapped. Today, this process could be accelerated using AI-facilitated visual identification technologies.

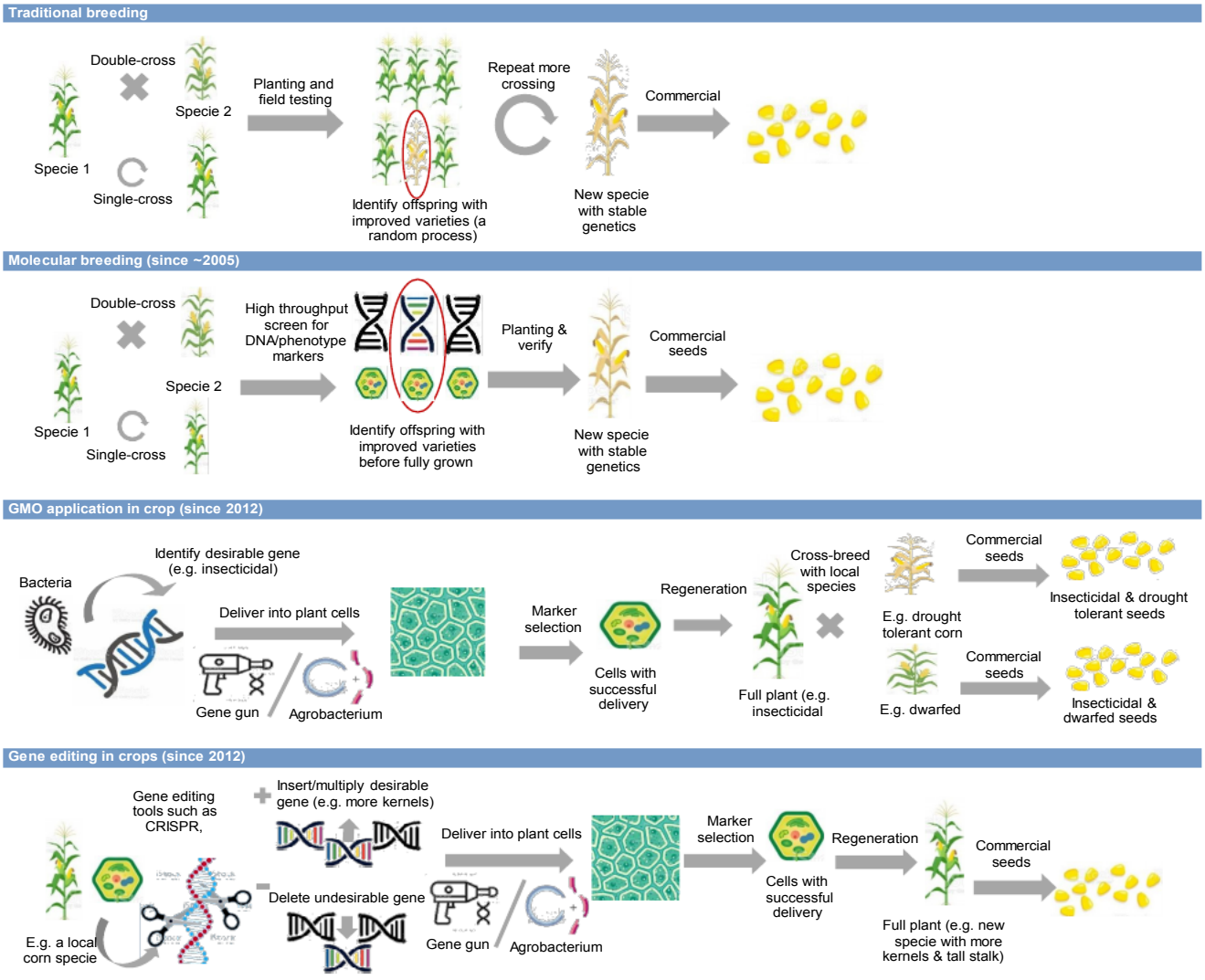
GMO crops: The use of GMO, or genetically modified organisms, on commercial crops started in 1996. Genetic materials are modified artificially through transgenic activity, or transferring genes among species. For example, GMO Bt-corn and soybean, are two of the most widely planted GMO crops globally that show good resistance to insects. The "Bt" basically refers to a bacterium called Bacillus thuringiensis, which produces a

protein that is toxic to some insects. Scientists transferred DNA in that bacteria responsible for producing Bt-protein into corn and soybean's genome, which enabled the crops to produce natural pesticide by themselves.

Gene-editing of crops: By using modern gene-editing tools such as CRISPR-Cas9, scientist are able to manipulate the gene of plant seeds and create traits that could service different requirements and preferences of end agriculture products. Traits created can be yield enhancement in rice, vegetative size increase, resistance to insects, changed fragrance and color etc. to manipulating the existing traits of a plant, e.g. size of fruit, plant height, drought tolerance etc.

In recent years, utilizing more advanced bio-tech tool, more advanced seed breeding are being carried through genome wide association study (or GWAS 全基因组关联分析), gene editing (基因编辑), and haploid breeding（单倍体育种).

Exhibit 53: Illustration of technological processes behind seed breeding



Source: Goldman Sachs Global Investment Research

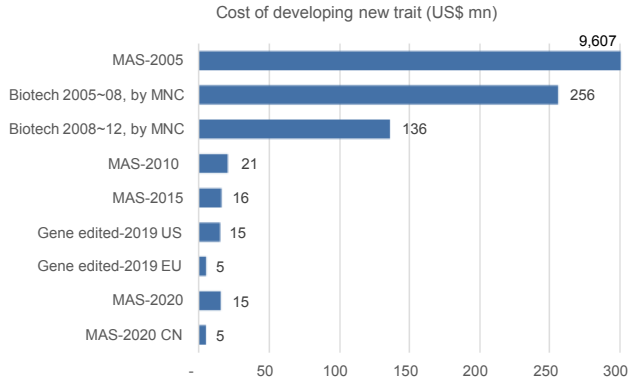
Bio-tech tools – faster speed and cheaper cost

Gene sequencing is a widely used tool in modern seed breeding techniques including GMO, gene-editing and marker-assisted molecular breeding. Over the past decades, the cost of gene sequencing has come off dramatically by 1mn times, with a speed that is thousand times faster. The unprecedented fall in cost and surge in speed of gene sequencing makes marker-assisted molecular breeding a more powerful tool than ever, in developing new traits in seed breeding.

The breeding processes essentially work in a way to select desirable traits with some hundred thousands to millions screening iteration of seedlings, by sequencing a few thousands of bp (base pairs) each time. With the technology development in sequencing tools, the cost of developing new traits has come off from nearly US$9.6bn US$ in 2005, to US$130-260mn in 2008-2012, and US$5-15mn in recent years, (based on survey to MNC seed companies eg. Monsanto, Dow, DuPont, Sygenta etc. conducted by Croplife.org, Phillips McDougall, Rim Lassoued, Peter W.B. Phillips, Stuart J. Smyth & Hayley Hesseln (2019), NHGRI, NBS).

A typical new trait in molecular breeding would require screening tests of molecular markers ranging from a few hundred thousand to a few millions, according to a research published on nature genetics (source link). Each screening would include ~10,000 gene-markers to be read and tracked. Assuming 1mn screening for each trait, the total cost to complete such a screening program would be Rmb 60bn before 2008, yet possibly below Rmb100mn in China in 2020. It would translate into a positive investment in recent years, versus breakeven before 2010 or earlier. Considering potential extra charges in seed pricing given the enhanced quality (e.g. higher yield, drought tolerance etc.), seed company's payback period of investment maybe less than 5 years, in our estimates.

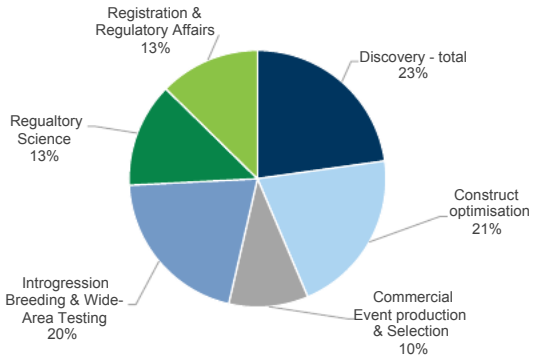
Exhibit 54: Cost of new trait development



Based on survey to MNC seed companies eg. Monsanto, Dow, DuPont, Sygenta etc. conducted by Croplife.org and Phillips McDougall

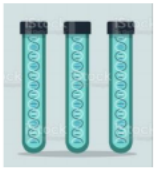
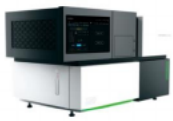
Source: Croplife.org, Phillips McDougall, Rim Lassoued, Peter W.B. Phillips, Stuart J. Smyth & Hayley Hesseln (2019), NHGRI, NBS, Goldman Sachs Global Investment Research

Exhibit 55: Cost breakdown for a new bio-tech trait



Source: Rim Lassoued, Peter W.B. Phillips, Stuart J. Smyth & Hayley Hesseln (2019), NHGRI, Goldman Sachs Global Investment Research

Exhibit 56: Gene sequencing procedures

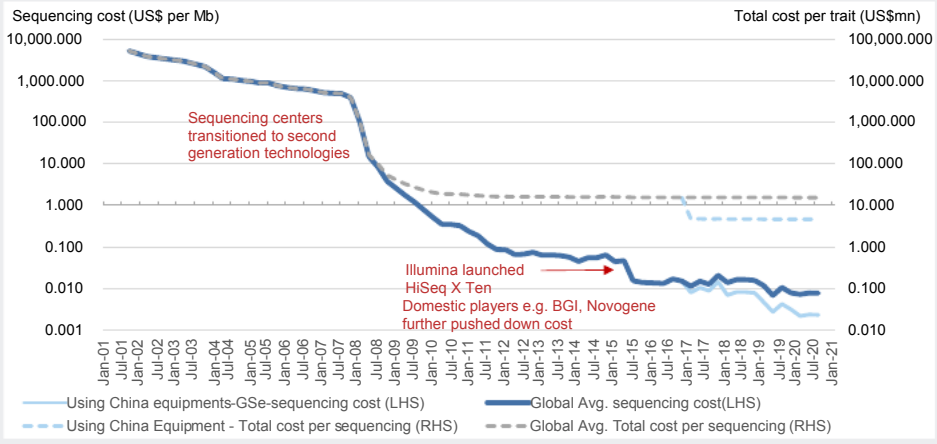
	Sequencing	Whole genome analysis	Fast screening	Predictive breeding
No of base/ no of pairs	Full DNA set (a few hundred mn bp)/ a few tens of pairs	40K - 56 Kbp/ a few hundreds - thousands pairs	within 5/ a few thousands to 10 thousands pairs	1K-10Kbp/ a few thousands to a few hundred thousands pairs
Required tech (equipment)				
	Next-generation sequencing (NGS)	Gene solid and liquid chips	Taqman & KASP systems	Group B Streptococcus (GBS) & Polymerase chain reaction (PCR)
Sequencing System (Price)				
	Global: Illumina's HiSeq 2500 - Earlier model (US$10mn)	Global: Illumina's HiSeq X Ten - current model (US$10 mn)	China: Novoseq 6000 (US$9.85 mn)	China: BGI - BGISEQ-500 (US$3 mn)

Source: Company data, Goldman Sachs Global Investment Research

The story of gene sequencing - beyond Moore's law

Gene sequencing is a widely used tool in modern seed breeding techniques including GMO, gene-editing and marker-assisted molecular breeding. Over the past decades, the cost of gene sequencing has come off dramatically by 1mn times, with a speed that is thousand times faster, a critical technology breakthrough that has empowered seed breeding. For example, it would cost US$100k+ for each Mb (mega-base, a units of DNA length, referring to 1 million base pairs) in 2008, and less than US$1 cent in 2016 and US$0.3 cent today in China. To put numbers in context, the Human Genome Project, that tested the full genome of human, took over 10 years and cost nearly US$3bn using the 1st generation Sanger sequencing. The cost is now below US$1,000 and takes less than a day. For plant gene sequencing, it implies it would take just 4 hours.

Exhibit 57: Cost of gene sequencing follows a pattern similar to "Moore's Law"



Source: NHGRI, Illumina, BGI, Novogene

Ecosystem seed

Exhibit 58: Ecosystem of seed value chain – global and China

	Company/Inst	Country	Subsidiary	ticker iflisted	Seed development				Analytic tools			Seed Prod	Seed dist
					GMO traits		Gene-editing	Germplasm	Geno - type	Pheno - type	Field /env		
					Patented	Licensed							
Private sector seed companies													
Integrated	Corteva	US	Dow	CTVA	√	√	√	√	√	√	√		
			DuPont Pioneer		√	√	√	√	√	√	√	√	√
	Bayer	US	Monsanto	BAYGn.DE	√	√	√	√	√	√	√	√	√
			Delta&Pine Land			√	√	√				√	√
			Aventis Crop Sci			√	√	√				√	√
	ChemChina+Sinochem	China	Syngenta		√	√	√	√	√	√	√	√	√
			Nidera Seeds			√	√	√				√	√
			Winall	300087.SZ				√				√	√
	BASF	Germany	Agri Solutions	DASFn.DE	√	√	√	√			√	√	√
			Prior Bayer veg		√	√	√	√				√	√
China	Dabeinong (大北农)	China	DBN China	002385.SZ	√								
			DBN Argentina		√								
	Longping (隆平高科)	China	Longping Biotech	000998.SZ				√				√	√
			(Prior Dow Brazil)		√			√				√	√
	HZ Ruifeng (杭州瑞丰)	China			√								
	Denghai （登海）	China		002041.SZ				√				√	√
	Zhongnongfa Seed(农发)	China		600313.SS				√				√	√
	Fengle(丰乐种业)	China		000713.SZ			√	√				√	√
	Dunhuang(敦煌种业)	China		600354.SS				√				√	√
China	Stine	US				√		√			√	√	√
	Land O'Lakes	US				√		√			√	√	√
	Merschman Seeds	US						√					
	AgReliant Genetics	US/Canada				√		√				√	√
	Groupe Limagrain	France				√		√				√	√
	KWS Saat	Germany				√		√				√	√
	Don Mario	Argentina				√		√				√	√
	Calyxt	US		CLXT			√					√	
	EMBRAPA	Brazil			√	√						√	√
	Bioceres	Argentina			√	√		√	√	√	√		
	Sakata Seed	Japan		1377.T				√				√	√
Analystical tools and services													
Analytic solutions	Benson Hills	US							√	√			
	Epicrop Technologies	US											
	Microsoft	US	Azure FarmBeats	MSFT					√	√	√		
	NRGene	US							√				
	Farmers Business Network	US									√		√
	Nynomic AG	Germany	LemnaTec	M7U						√			
	PhenoTrait Tech (慧诺瑞德)	China							√	√			
	AgriPheno (上海泽泉)	China								√			
	Biobin (百奥云)	China								√			
	Molbreeding (博瑞迪)	China							√				
Equip.	Illumina	US							√				
	Thermofisher	US							√				
	Beijing Genomics Institute	China							√				
	Novogene	China							√				
Public sector crop research													
China	China Agricultural U. (Maize Center)	China					√	√					
	Shanghai Jiao Tong University	China			√								
	CAAS (中国农业科学院生物技术研究所)	China			√								
	CAS (遗传与发育所&植物逆境中心)	China											
ex-China	Iowa State University	US			√		√	√					
	Stanford University	US			√		√	√					
	University of Minnesota	US			√		√	√					
	University of Arizona	US			√		√	√					
	Texas Tech University	US			√		√	√					
	University of Idaho	US			√		√	√					

Source: Company data, Data compiled by Goldman Sachs Global Investment Research

The eco-system for seed breeding is ultimately centered around germplasm developers

and bio-tech trait owners, supported by providers for advanced tools and integrated systems for analysis of genetic variation and function, along with the emerging analytical service providers for small players.

(Bio-tech) traits owners

Trait owners, in genetic engineered crops, have patent rights (or similar rights in different forms) for the modification technology of introducing the specific gene sequence to the plant seed, that lead to desired traits. Through their ownership of the intellectual property, they are granted a period of exclusivity and profit, so as to support and encourage their investment on R&D and innovations. The average trait owner spends 2-4% of its revenue on R&D, based on historical financials. In 2018-2012, the average cost of development of a new GMO trait was US$136 mn, and US$5-15mn in recent years, (based on survey by MNC seed companies eg. Monsanto, Dow, DuPont, Syngenta etc. conducted by Croplife.org, Phillips McDougall, Rim Lassoued, Peter W.B. Phillips, Stuart J. Smyth & Hayley Hesseln (2019), NHGRI, NBS).

For example, Monsanto's Roundup-Ready soybeans was granted patents in 1996 (US Patent Nos. 5,352,605 and RE39,247), for a patented terms of 20 years. Based on delivered opinion of US supreme court (569 U.S.278, 2013), the patents covered various aspects of its Roundup-Ready technology (protected from herbicides roundup's key ingredient glyphosate), including a seed incorporating the genetic alteration. This patent right, in Monsanto's case, prohibited the farmers from replanting harvested seeds, through a licensed agreement.

For Brazil and Argentina which adopted GMO after the US, trait owners entered the local market as trait providers, who licensed the GMO trait technology to local seed companies and shared the trait usage fee. Under this model, trait owners do not need to build up their own distribution network in the country, and independent local developers provide cost competitive solutions versus MNCs.

Germplasm owners

Germplasm owners collect germplasm and breed in-bred pure lines (crop strain identical to each other in genotype derived from long inbreeding). They provide basics to create hybrid seeds, including molecular breeding, and also an essential part of GMO trait delivery to seeds by working with GMO trait owners. Germplasm owners, are also able to capture part of the seed value by collaborating with the bio-tech trait owners, or capture seed value on their own through hybrid single-crossing. The advancement in molecular marker assisted breeding and gene testing tool should further enhance germplasm's capture rate in the coming years. Based on historical financials, germplasm owners average ROE has increased from 0-14% in 2011 to 2-23% in 2020.

According to FAO (2009 report), there are more than 1750 individual genebanks worldwide, holding 7.4 million accessions, of which 4.6 million were for germplasm of crops, and nearly 90% were conserved by national government genebanks. Based on FAO, the four largest national genebanks with Crop Germplasm Resources are:

- Chinese Academy of Agricultural Sciences (ICGR-CAAS) in China (China holds the

largest collection of soybean germplasm, or nearly 14% of global accessions, according to FAO).

- National Center for Genetic Resources Preservation (US)
- National Bureau of Plant Genetic Resources (NBPGR) (India)
- N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry (VIR)

A high quality germplasm company takes years to develop its portfolio, therefore its competitive edge, once built up, should be more sustainable. For example, Japanese seed company, Sakata Seed, began its development in broccoli in 1960 and only developed its first F1 in 1970. But through years of accumulative effort on broccoli seeds development, it is now taking 60% of the global market shares of broccoli (GS report link).

The Germplasm segment tends to be more fragmented than traits segment, as quality difference among hybrid seed products tends to be marginal. In Europe and China, where GMO market was strictly regulated, most seed companies, such as KWS and Limagrain were selling traditional hybrid seeds. Based on data from USDA, and company disclosures from Euroseeds, Agbioinvestor, the top 3 producers in Europe, Corteva, KWS, and Vilmorin, hold a market share of 25%. The top 3 in China (Longping, Denghai, WinAll) hold less than 10% market share. In the US market, before GMO was deregulated, the top 3 players took up ~50% market share in 1980s. Nevertheless, consolidation could accelerate once GMO is introduced, according to the US.

Integrated seed MNCs

The global seed industry landscape shifted dramatically in the 1990s and early 2000s after the commercialization of bio-technology such as GMO in North and South America, followed by another round of M&A and restructuring after 2010s when GMO became almost fully penetrated in America. The consolidation enabled strong competitive advantages through centralized platform that enhanced R&D capabilities in terms of patent and data aggregation, and other resources. Today, the major MNCs standing out are Bayer (which acquired Monsanto), Corteva (merged from Dow and Dupont's crop units and Pioneer Seeds), Sinochem (which acquired Syngenta),

In the US market, Bayer-Monsanto, Corteva and Syngenta are the three biggest integrated seed players with 70%+ market share. They participate in full seed supply chain, including breeding, distribution and uses AI/Cloud platforms to advise farmers on planting decision and management. However, their presence in China has been limited partly due to regulation restrictions with the exception of the acquisition of Syngenta by Chemchina.

- Monsanto once introduced GMO cotton seeds into China via its joint venture with Hebei local government in 1998, and reached 30 thousand tonne of annual sales at its highest in 2002, however, with more local companies starting to breed GMO cotton seeds, the market share of Monsanto's joint venture company shrank significantly.
- Corteva's subsidiary Pioneer Seeds set up a joint venture with Denghai seed and

successfully launched a hybrid corn seed XY335 in 2005; it has since become the best-selling corn seed in China and maintains a top 10 position until today.

- Syngenta set up Syngenta Bio-tech Research Center in China in 2008, which focus on the domestic research of corn and soybean seeds. Syngenta also sells vegetable seeds on China market such as tomato seeds. Syngenta was acquired by ChemChina in 2015 for a price of US$43bn, the largest takeover by a Chinese company to date. ChemChina was lately merged with Sinochem in 2021. It's currently setting up an agriculture distribution and sourcing network for agriculture products, seeds, crop protection products as well as promoting new agriculture technologies.

3rd party service providers for analytical solutions & Ag bio-technology development

We also see the emerging trend of 3rd party service providers, for analytical solutions and breeding technologies. It effectively provides a consoldiated technology and R&D platform for small sized seed companies.

According to AgFunder, the upstream segment (food production focused) in the AgriFoodTech space attracted US$15.8bn venture capital financing in 2020, surpassing the downstream investment (food distribution focused) for the first time. In particular, the two sub categories of Ag bio-technology and Farm Management Software, Sensing & IoT attracted US$2.5bn investment in total. Among these, we see a growing number of companies trying to bring together the power of both bio-technologies and information technologies and create more efficient platforms for small scale seed breeders to conduct molecular breeding. Some of the examples are:

- Benson Hill, a US based company, developed a platform using AI and machine learning to help seed breeders enhance the predictability in molecular breeding and gene-editing process, particularly for crops of healthier qualities.
- BioBin (China) provides seed breeders with a database system to store and analyze phenotype and genotype information collected from breeding, as well as an APP as terminal for breeders to more efficiently collect phenotrait information in the field.

Advanced equipment and tool providers

Key drivers behind the paradigm of seed industry still lies with advancement of generic bio-technologies such as low cost gene-editing like CRIPSR-Cas9 system developed by Broad Institute and University of California, as well as 2nd generation gene-sequencing equipment developed by Illunima and some Chinese counterparts like BGI.

What is next for China

Beyond the potential launch of 1st generation GM seeds, there are much room and gaps to be addressed ahead in our view:

- ***Germplasm improvement:*** According to China Agriculture Science and Institution, (China bio-technology Journal), corn germplasm in China tends to have limited varieties, low yield intrinsic potential, poor density-tolerance, and poor insects-tolerance.
- ***Identify more functional genes and traits for future seeds breeding,*** through GWAS (genome wide association study) and CRISPR/Cas gene editing, combined with MAS (marker assisted selection) and GS (genomic selection). Much research work have started aiming to increase yield and quality, herbicide tolerance, effective ingressing, optimizing plant height, leaf shape, starch content etc.
- ***Germplasm resource consolidation and synergy*:** As much as China seed market is being segmented, each company also keeps its own germplasm resources, with limited sharing. In contrast, top three US corns seeds companies take up 80% market share. This was achieved through both organic growth and a few rounds of M&As after 1970s. On the national level, US National Plant Germplasm System (NPGS) was established in 1974, but its main facility the USDA/ARS National Laboratory for Genetic Resources Preservation (NLGRP) was completed as early as 1958 and collected almost a million accessions (sources: MOA Book, USDA/ARS, Baidu Baike, Wiki). China's national Crop Germplasm Resources Information System was established in 1986; the system has stored ~500 thousands accessions as of 2019. The system's first large storage center was completed in 2002 a with total capacity of ~600-700 thousands of accessions. A new facility with 1.5mn capacity commenced operations on Sep, 2021.
- ***Next generation GMO:*** On the product side, the US has started to promote 3rd & 4th generation products since 2015 vs. 1st and 2nd generation of filed products in China: US companies have launched new generation products with: 1) gene that produces protein that targets underground insects; 2) gene that is tolerant to non-glyphosate herbicides such as 2,4-D Choline and Dicamba; 3) gene that can modify corn's quality to increase its nutrition level if used as feed additives.

Company Sections

Dabeinong (002385.SZ, Buy, 12-m TP: Rmb13.6/sh): Leading bio-tech trait owner, the best play in China seed sector

002385.SZ	12m Price Target: Rmb13.6	Price: Rmb7.18	Upside: 89.4%

Buy

Market cap: Rmb29.7bn / $4.4bn
Enterprise value: Rmb35.8bn / $5.3bn
3m ADTV :Rmb620.0mn/ $92.4mn
China
China Agriculture
M&A Rank: 3
Leases incl. in net debt & EV?: No

GS Forecast

	12/21	12/22E	12/23E	12/24E
Revenue (Rmb mn)	31,328.1	37,793.8	45,541.2	56,295.0
EBITDA (Rmb mn)	417.0	863.8	2,377.9	3,813.8
EPS (Rmb)	(0.11)	(0.07)	0.14	0.32
P/E (X)	NM	NM	49.8	22.4
P/B (X)	3.3	2.8	2.7	2.4
Dividend yield (%)	0.0	0.0	0.6	1.3
N debt/EBITDA (ex lease,X)	6.7	4.9	2.1	1.5
CROCI (%)	3.3	6.8	13.7	18.8
FCF yield (%)	(3.6)	(4.6)	(2.0)	(1.5)

	6/21	12/21	6/22E	12/22E
EPS (Rmb)	0.12	(0.23)	(0.13)	0.06

Source: Company data, Goldman Sachs Research estimates, FactSet. Price as of 05 Aug 2022 close.

Initiate with BUY: Dabeinong (DBN) is a diversified agriculture products producer involved in animal feed, hog farming, seed breeding and other businesses. We expect strong topline revenue and earnings growth ahead, with a CAGR of 21-58% during 2023E-2025E in our base, non-GMO case, driven by its accelerated feed volume growth, and improvement in hog operation from being loss making in 2021A. We view DBN as the best positioned to capture the shared economic benefits from the potential introduction of 1st generation corn GM seeds in China in the coming years. Its long-term commitment in seed breeding should underpin sustainability of its leading position in China's seed sector. We initiate coverage on Dabeinong with a Buy rating and 12-month target price of Rmb13.6/sh, which includes Rmb9.1/sh from the traditional business and Rmb4.5/sh from GMO.

Leading domestic GMO trait developer: As of 2H22, DBN has received 4 approved bio-tech traits in China for the 1st generation of GM corn seeds, the most among all peers. The traits include pest resistance against major corn borers and armyworm, and herbicide (glyphosate and glufosinate) tolerance, combined with the highest regional coverage. The traits coverage implies 25-38% market shares in the first 3-5 years of launch, and 56-63% in the long term, in our estimates. We estimate potential trait license fee should bring DBN nearly Rmb0.7bn by 2025E and Rmb2.0bn by 2027E on PBT, or Rmb0.06/sh and Rmb0.17/sh EPS, contributing to 4% and 16% of earnings.

Accelerating growth in feed consolidation: Feed operation, mostly hog feed, remains the largest contributor for DBN, attributing 78% of total sales in 2021A. DBN is accelerating the expansion, aiming to reach 10% of market share from its current 3-4% level, and 20-30% in the long-run. We expect the company's feed sales volume to grow from 5.9mnt in 2021A at a 20% CAGR in the coming years, through M&A and new construction. Its recent acquisitions should add a total of 3.8mnt and an additional capacity of 1.2mnt is expected to be built up through newly proposed fundraising. We expect the gross profit from feed operation to increase from Rmb2.9bn in 2021A to

Rmb7.3bn in 2025E, mostly driven by volume consolidation.

Valuation and target price: Our valuation is based on SOTP, including 1) Rmb7.9/sh on feed; 2) Rmb0.5/sh for hog; 3) Rmb0.5/sh for traditional seeds; 4) Rmb4.6/sh for GMO; 5) Rmb0.3/sh for plant and animal protection, and Rmb0.1/sh for its other businesses. Our target price implies PE of 67x on 2023E, PE of 31x on 2024E, and PE of 22x on 2025E.

Key risks: 1) Uncertainty in hog prices which can be affected by industry supply changes including both domestic supply and imports. Potential launch of ASF vaccine can have a material impact on both supply and costs. 2) Lower than expected consumption demand on high-end hog products amid economy downturn and COVID-19 outbreaks 3) Slower-than-expected government approval of GM seed commercialization.

Leading domestic GMO trait developer

We expect seed prices in China to rise by ~30-40% in the coming years, and DBN to be best positioned to capture the shared economic benefits from the potential introduction of 1st corn GM seeds in China in the coming years.

As of 2H22, Dabeinong has already received GMO bio-security licenses for 4 corn trait products and 1 soybean trait product, accounting for nearly one-third of total approved traits in China. The 4 corn traits approved include DBN9936, DBN9501 and DBN3601T, and DBN9858 as refugee. Specifically, we highlight:

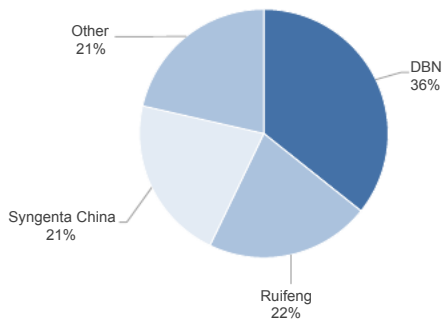
- DBN9936 is a stacked trait product proved to be 95%+ effective against Asian corn borer, bollworm, and arymworm, and can tolerate up to 4x use of glyphostate and glufosinate given its embedded herbicide-tolerance **epsps** genotype.
- DBN3601T is the stacked corn trait combining the genotype of DBN9501 and DBN9936, which provides comprehensive protection against all major pest disease types, and can tolerate up to 4x use of glyphostate and glufosinate according to field test results.
- Per Dabeinong's estimates in the bio-security filing, Asian corn borers alone affect 13mn ha of corn (~30% of total acreage) in China every year, and causes 10-50% yield losses, and weed control is one of the biggest source of labor cost in corn production (we estimate ~50% of labor cost and ~20% of total production cost respectively).
- Field test on DB9936 suggested net benefit of Rmb226/mu, and Rmb389/mu for DBN3601T based on management feedback.

In DBN GM corn seeds study performed by the company, its 1st generation traits brought 10-15% higher yield by reducing yield losses caused by pests, reduced mycotoxin by 80% (thus 2-4% better grain quality), and also improved production efficiency by 10-15% - all translate into Rmb226-389 higher income for farmers for each mu of corn planted. In its southwest corn tests, the improvement reached Rmb389 per mu, driven by higher yield recovery from the armyworm impact.

We expect the first generation of GMO commercialization to expand the total seed market in China by 3-35%, generating Rmb0.9-10.7bn of incremental benefit for the industry during 2023E-2027E, and reaching 90% by end of the term. Among the GMO benefit shared to all stakeholders, 40% is expected to be allocated to trait owners such as Dabeinong, 20% for seed companies and the rest for retailers and distributors. We expect the ramp up of GMO deployment would bring DBN a net benefit of Rmb250-949mn from 2023E to 2025E, increasing DBN's profit by 4%-9% during the same period.

Regarding the company's global expansion, Dabeinong's soybean product DBN9004 has received full commercial planting license in Argentina, designed with tolerance of both glyphosate and glufosinate. In our base case scenario, we factor in a 5% market share of Dabeinong's soybean product in the Argentina market, which, by our estimate, would lead to a net benefit of Rmb114-285mn from 2023E to 2027E.

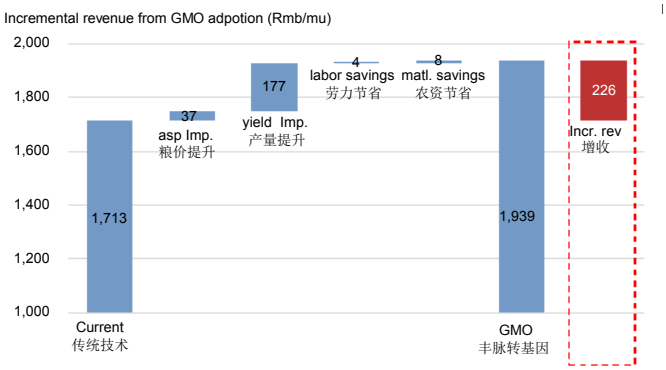
Exhibit 59: Bio-security approved corn and soyben traits by producer as % of total



Including approved corn and soyben traits as of 1H22

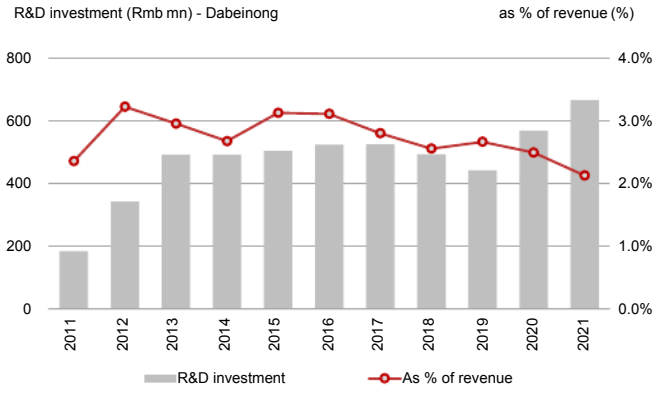
Source: MOA, Company data, Goldman Sachs Global Investment Research

Exhibit 60: Seed economics - DBN9936 for spring corn in Northeast China



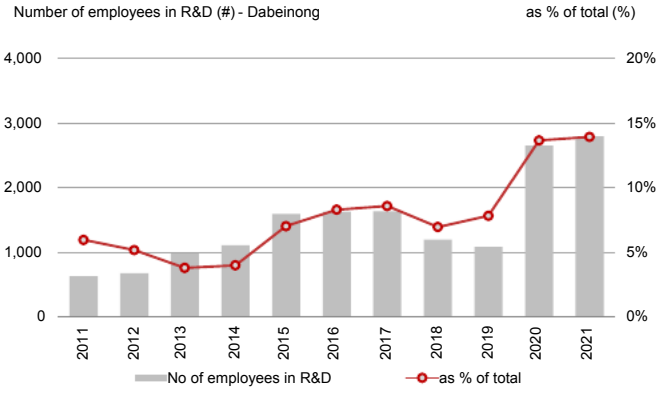
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 61: R&D investment - Dabeinong



Source: Company data

Exhibit 62: Number of employees in R&D



Source: Company data

Exhibit 63: GMO economics - DBN

Corn		2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E/LT
Industry-GMO Penetration	%	0.0%	5.0%	23.0%	41.0%	59.0%	77.0%	90.0%	90.0%	90.0%	90.0%
Industry-GMO value addition	Rmb mn	-	94	871	2,357	4,575	7,550	10,711	10,711	10,711	10,711
Industry-Germplasm improvement TAM-LT	Rmb mn	-	-	-	-	-	-	-	3,090	6,246	11,847
Industry-GMO value shares to traits	%	0.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Industry-GMO value shares to germplasm	%	0.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
DBN-Conventional mkt shr, corn	%	0.4%	0.5%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
DBN-GMO mkt shr, corn	%	0.0%	38.0%	38.0%	38.0%	38.0%	41.6%	45.2%	48.7%	52.3%	55.9%
DBN-GMO-value to trait owners	Rmb mn	-	14	132	358	695	1,256	1,935	2,088	2,241	2,395
DBN-GMO-value to germ owners	Rmb mn	-	0	1	4	7	11	16	16	16	16
Soybean		**2021**	**2022E**	**2023E**	**2024E**	**2025E**	**2026E**	**2027E**	**2028E**	**2029E**	**2030E/LT**
Industry-GMO Penetration	%	0.0%	0.0%	5.0%	17.9%	30.7%	43.6%	56.4%	69.3%	82.1%	90.0%
Industry-GMO value addition	Rmb mn	-	-	21	112	256	256	256	256	256	256
Industry-Germplasm improvement TAM-LT	Rmb mn	-	-	-	-	-	198	450	759	1,124	1,461
Industry-GMO value shares to traits	%	0.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Industry-GMO value shares to germplasm	%	0.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
DBN-Conventional mkt shr, soybean	%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
DBN-GMO mkt shr, soybean	%	0.0%	0.0%	25.0%	25.0%	25.0%	28.6%	32.2%	35.7%	39.3%	63.0%
DBN-GMO-value to trait owners	Rmb mn	-	-	2	11	26	29	33	37	40	65

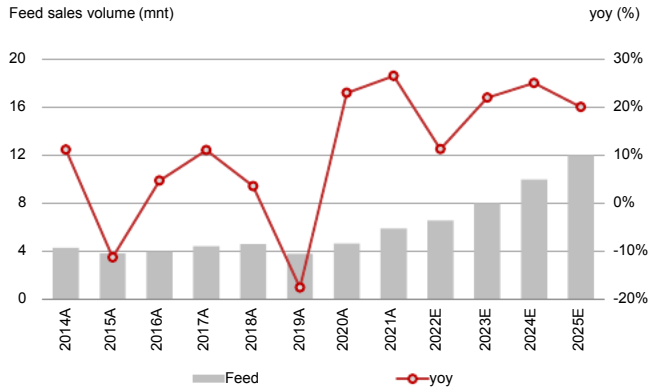
Source: MOA, ISAAA, Wind, Company data, Goldman Sachs Global Investment Research

Accelerating growth in feed consolidation

Feed business remain the largest contributor to DBN's business, attributing 72% of total sales in 2021A with hog feed accounting for three-quarters of the segment revenue. Its high-end feed product that is designed for piglet and sow to improve survival rate and PSY, is enjoying a higher margin level of ~25% versus 15-20% for ordinary feed. Dabeinong's feed sales volume had been growing at a 6% CAGR in the past 5 years, while the company is expecting to expand the feed business proactively going forward, aiming to reach 10% of market share from its current 3-4% level, and 20-30% in the mid- and long-term to further consolidate the market. We expect the company's feed sales volume to grow at a 20% CAGR from 2022E to 2025E, through M&A and new construction. Its proposed acquisitions of animal feed units from Jiangxi Zhengbeng ("正邦") (002157.SZ - Not Covered), and Hunan Jiuding ("九鼎") (private), would add a total of 3.8mnt of new feed volume carrying forward, per management comment; meanwhile, an additional capacity of 1.2mnt, including 450kt of high-end feed, 180kt of functional feed, and 570kt of swine feed, is expected to be built up in the near term through the company's proposed fundraising plan in June, subject to the regulatory approval.

We expect DBN to report gross profit of Rmb3,902-7,276mn during 2022-2025E, versus Rmb2,929mn in 2021A.

Exhibit 64: Feed sales volume growth - DBN



Source: Company data, Goldman Sachs Global Investment Research

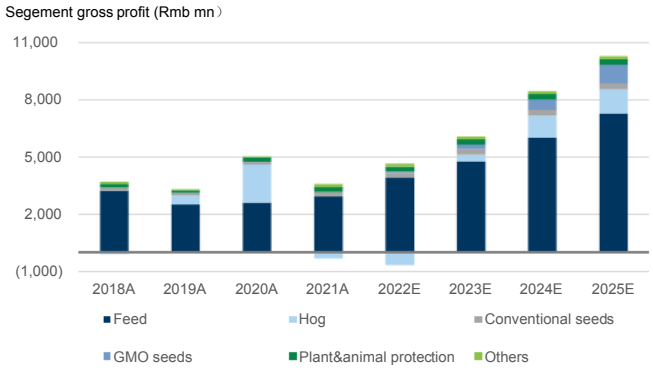
Exhibit 65: Use of fund summary - DBN private placement on Jun, 2022

Project English name	Project Chinese name	Capacity ktpa	CAPEX Rmb mn
Feed			
Guangxi - swine feed	24万吨猪饲料生产线项目	240	120
Xinjiang - swind feed	12万吨猪饲料加工厂建设项目	120	60
Liaoning - ruminant feed	辽宁盛得大北农生产反刍饲料基地项目	n.a.	100
Liaoning innovation center	大北农辽宁区核心科技园建设项目	n.a.	350
Yunnan - functional feed	18万吨微生态功能性生物饲料建设项目	180	105
Hubei - swine feed	24万吨饲料生产加工项目	240	100
Hebei - high-end feed	45万吨高端饲料项目	450	180
		1,230	**1,015**
Hog			
Wuping - industrial park	武平闽台农牧合作创业园（二期）	n.a.	149
Hebei - bio-tech center	大北农（玉田）生猪科学试验中心项目	n.a.	100
			249
Tech and others			
Biotech innovation park	大北农生物农业创新园项目	n.a.	1,870
IT information system upgrade	IT-信息化系统升级改造项目	n.a.	77
Working capital	补充流动资金	n.a.	676
			2,623

Source: Company data, Goldman Sachs Global Investment Research

Dabeinong has been partnered with small- and mid-scale hog farmers since 2016 to double its volume on hog farming business, which contributed over 2.5mn heads of controlled sales volume in 2021A. The company reported a loss of Rmb308mn, or equivalent Rmb1.0/kg of unit loss for its hog operation in 2021A, due to depressed hog prices and grain cost inflation. We expect DBN's hog business to stay loss-making in 2022E, while turning positive from 2023E onward to factor in normalized price cycle to report Rmb660mn of loss in 2022E, then Rmb348-1,255mn of gross profit from 2023E to 2025E, by assuming mid cycle price of Rmb18.1/kg, 10% discounted versus national hog price of Rmb20.0/kg (based on prior discounts), and production cost of Rmb16.0/kg.

Exhibit 66: Gross profit by sector - DBN



Source: Company data, Goldman Sachs Global Investment Research

Financials and valuations - DBN

Note: Our base case earnings do not include GM earnings pending the official launch of GM seeds commercialization. But we have included the GM impact in valuations and target price, taking a forward-looking approach.

We initiate on DBN with a BUY rating and 12m target price of Rmb13.6/sh, implying 89% upside. We expect the company to continue to be loss making in 2022E due to depressed hog operations, and then start to deliver earnings growth of 58% CAGR from 2023E to 2027E, driven by expanding feed business, stabilized hog prices and GMO value creation. Accordingly,

Feed: we expect the company's feed business to grow steadily driven by continuing capacity expansion, deliver a 26% CAGR in gross profit during 2021E-2025E and reach Rmb7,276mn in 2025, doubling its revenue with margin staying at 14% over the period.

Hog: We expect DBN's hog business to continue being loss-making in 2022E with ASP staying low at Rmb14.1/kg, while the company is expected to generate normalized profit from 2023E onward with normalized hog prices and production costs stabilizing.

Seed: In our base, non-GMO case, we expect DBN's conventional seed business to grow at 10% CAGR, accounting for 4-7% of total gross profit during 2022E-2025E. The potential launch of 1st generation of GMO seeds is expected to translate into a net benefit of Rmb250-956mn during 2023E-2025E.

In our base, non-GMO case, we expect DBN to report net recurring loss of Rmb219mn in 2022E, then sequentially improve to Rmb679-1696mn during 2023E-2025E, which is 41-68% lower than consensus, mainly due to the margin loss on the hog sector, driven by lower hog price assumption which is benchmarking national hog price of Rmb15.6/sh in 2022E, Rmb18.0/sh in 2023E, and return to mid-cycle price of Rmb20.0/sh in 2024E. We also see FCF to be Rmb-1,457mn in 2022E given the loss-making hog operation and expanding CAPEX, while expect it to improve sequentially from 2023E onward with net gearing of 41%-47% during the same period.

On the cost front, DBN announced its new batch of share incentive plan in Sep, 2021 with set KPI on feed, targeting to reach 20%-60% of external feed sales yoy growth during 2021A to 2023E, which would translate into Rmb 29-206mn of additional administration expenses during 2022E to 2024E, according to the company's announcement.

During Jan-Feb 2022, DBN announced plans to acquire two regional feed producers, which includes 8 animal units of Jiangxi Zhengbang ("正邦") (002517.SZ - Not Covered), and a controlling stake in Hunan Jiuding ("九鼎" - private) with an aggregate transaction value of Rmb3.3-3.8bn. The proposed transactions equate to 15-19x Zhengbang's 2022E projected earnings, and 31x Jiuding's 2022E projected earnings, respectively. The transactions are expected to complete no later than early 2023, pending regulatory approval. According to management, the completion of the transaction would increase DBN's feed sales volume by 3.8mnt. We have not included these in our DBN financials.

In June 2022, the company rolled out its A-share private placement plan, aiming to raise

a total of Rmb2.3bn to fuel its feed expansion by issuing not more than an additional 10% of its existing shares, give or take based on final issuing price. According to the company's announcement, 36% of the raised funds would be used for the building of additional 1.2mnt of feed capacity, 30% for R&D, 30% for net working capital, and 10% for information system upgrade. On a diluted basis, we expect DBN's EPS to be Rmb0.13-0.35/sh from 2023E to 2025E, ~9% lower compared to undiluted basis.

Exhibit 67: Key assumptions and financials - DBN (base case scenario)

Key assumptions and financials							
		2020A	2021A	2022E	2023E	2024E	2025E
Feed	mnt	4.7	5.9	6.6	8.0	10.0	12.0
incl. hog high-end	%	28%	31%	30%	30%	30%	30%
mkt shr	%	5%	7%	6%	8%	9%	12%
ASP - feed	Rmb/t	3,558	3,863	4,405	4,406	4,453	4,490
Unit GP - feed	Rmb/t	561	497	595	595	601	606
Revenue-Total	Rmb mn	22,814	31,328	37,794	45,541	56,295	66,497
Feed	Rmb mn	16,587	22,695	28,897	35,249	44,534	53,880
Hog farming	Rmb mn	3,801	4,699	4,888	6,202	7,581	8,339
Seeds	Rmb mn	408	561	617	678	746	821
Plant protection	Rmb mn	165	181	199	219	241	265
Animal protection	Rmb mn	326	352	352	352	352	352
Other	Rmb mn	1,526	2,841	2,841	2,841	2,841	2,841
Gross profit-total	Rmb mn	5,026	3,274	3,925	5,823	7,905	9,320
GP-Feed	Rmb mn	2,615	2,929	3,902	4,760	6,014	7,276
GP-Hog	Rmb mn	1,990	(308)	(660)	348	1,141	1,255
GP-Seeds total	Rmb mn	150	234	257	283	311	342
GP-Traditional seeds	Rmb mn	150	234	257	283	311	342
GMO-value to trait owners-Argentina	Rmb mn	-	-	-	-	-	-
GMO-value to trait owners-Corn	Rmb mn	-	-	-	-	-	-
GMO-value to trait owners-Soybean	Rmb mn	-	-	-	-	-	-
GMO-value to germ owners	Rmb mn	-	-	-	-	-	-
GP- Plant protection	Rmb mn	55	60	66	73	80	88
GP- Animial protection	Rmb mn	169	197	197	197	197	197
GP- Others	Rmb mn	48	162	162	162	162	162
GPM-total	%	22%	10%	10%	13%	14%	14%
GPM-Feed	%	16%	13%	14%	14%	14%	14%
GPM-Hog	%	52%	-7%	-13%	6%	15%	15%
GPM-Seeds total	%	37%	42%	42%	42%	42%	42%
GPM-Traditional seeds	%	37%	42%	42%	42%	42%	42%
GPM- Plant protection	%	33%	33%	33%	33%	33%	33%
GPM- Animial protection	%	52%	56%	56%	56%	56%	56%
GPM- Others	%	3%	6%	6%	6%	6%	6%
EBIT	Rmb mn	3,029	(446)	(135)	1,508	2,991	3,642
EBITDA	Rmb mn	3,783	494	900	2,616	4,210	4,990
EBITDA-recurring	Rmb mn	3,512	570	982	2,698	4,292	5,072
Net Profit	Rmb mn	1,956	(440)	(300)	597	1,326	1,614
Net Profit-recurring	Rmb mn	1,685	(364)	(219)	679	1,408	1,696
EPS	Rmb/sh	0.482	(0.106)	(0.073)	0.144	0.320	0.390
EPS-recurring	Rmb/sh	0.402	(0.088)	(0.053)	0.164	0.340	0.410
Operating cash flow	Rmb mn	1,856	1,149	278	1,310	2,045	2,486
Investing cash flow	Rmb mn	(1,525)	(1,615)	(1,735)	(1,939)	(2,526)	(2,870)
Free cash flow	Rmb mn	332	(466)	(1,457)	(629)	(481)	(384)
Net debt	Rmb mn	2,666	2,795	4,252	4,880	5,540	6,322
Net debt/Equity	%	24%	26%	41%	44%	45%	47%
FCF/sh	Rmb/sh	0.080	(0.112)	(0.352)	(0.152)	(0.116)	(0.093)
BV/sh	Rmb/sh	2.626	2.593	2.520	2.664	2.941	3.235
ROE	%	18.5%	-4.0%	-2.8%	5.6%	11.4%	12.6%
ROIC	%	13.7%	-3.5%	-0.5%	4.0%	5.8%	6.2%

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 68: Key assumptions and financials - DBN (GMO scenario)

Key assumptions and financials		2020A	2021A	2022E	2023E	2024E	2025E
Feed	mnt	4.7	5.9	6.6	8.0	10.0	12.0
incl. hog high-end	%	28%	31%	30%	30%	30%	30%
mkt shr	%	5%	7%	6%	8%	9%	12%
ASP - feed	Rmb/t	3,558	3,863	4,405	4,406	4,453	4,490
Unit GP - feed	Rmb/t	561	497	595	595	601	606
Revenue-Total	Rmb mn	22,814	31,328	37,865	45,791	56,839	67,453
Feed	Rmb mn	16,587	22,695	28,897	35,249	44,534	53,880
Hog farming	Rmb mn	3,801	4,699	4,888	6,202	7,581	8,339
Seeds	Rmb mn	408	561	688	928	1,290	1,776
Plant protection	Rmb mn	165	181	199	219	241	265
Animal protection	Rmb mn	326	352	352	352	352	352
Other	Rmb mn	1,526	2,841	2,841	2,841	2,841	2,841
Gross profit-total	Rmb mn	5,026	3,274	3,996	6,072	8,449	10,276
GP-Feed	Rmb mn	2,615	2,929	3,902	4,760	6,014	7,276
GP-Hog	Rmb mn	1,990	(308)	(660)	348	1,141	1,255
GP-Seeds total	Rmb mn	150	234	328	532	855	1,298
GP-Traditional seeds	Rmb mn	150	234	257	283	311	342
GMO-value to trait owners-Argentina	Rmb mn	-	-	57	114	171	228
GMO-value to trait owners-Corn	Rmb mn	-	-	14	132	358	695
GMO-value to trait owners-Soybean	Rmb mn	-	-	-	2	11	26
GMO-value to germ owners	Rmb mn	-	-	0	1	4	7
GP- Plant protection	Rmb mn	55	60	66	73	80	88
GP- Animial protection	Rmb mn	169	197	197	197	197	197
GP- Others	Rmb mn	48	162	162	162	162	162
GPM-total	%	22%	10%	11%	13%	15%	15%
GPM-Feed	%	16%	13%	14%	14%	14%	14%
GPM-Hog	%	52%	-7%	-13%	6%	15%	15%
GPM-Seeds total	%	37%	42%	48%	57%	66%	73%
GPM-Traditional seeds	%	37%	42%	42%	42%	42%	42%
GPM- Plant protection	%	33%	33%	33%	33%	33%	33%
GPM- Animial protection	%	52%	56%	56%	56%	56%	56%
GPM- Others	%	3%	6%	6%	6%	6%	6%
EBIT	Rmb mn	3,029	(446)	(69)	1,739	3,494	4,525
EBITDA	Rmb mn	3,783	494	966	2,846	4,713	5,873
EBITDA-recurring	Rmb mn	3,512	570	1,048	2,928	4,795	5,955
Net Profit	Rmb mn	1,956	(440)	(244)	798	1,767	2,395
Net Profit-recurring	Rmb mn	1,685	(364)	(162)	880	1,848	2,477
EPS	Rmb/sh	0.482	(0.106)	(0.059)	0.193	0.427	0.578
EPS-recurring	Rmb/sh	0.402	(0.088)	(0.039)	0.212	0.446	0.598
Operating cash flow	Rmb mn	1,856	1,149	333	1,506	2,477	3,254
Investing cash flow	Rmb mn	(1,525)	(1,615)	(1,735)	(1,939)	(2,526)	(2,870)
Free cash flow	Rmb mn	332	(466)	(1,402)	(433)	(49)	384
Net debt	Rmb mn	2,666	2,795	4,197	4,630	4,918	5,064
Net debt/Equity	%	24%	26%	40%	41%	38%	34%
FCF/sh	Rmb/sh	0.080	(0.112)	(0.339)	(0.105)	(0.012)	0.093
BV/sh	Rmb/sh	2.626	2.593	2.534	2.726	3.095	3.546
ROE	%	18.5%	-4.0%	-2.3%	7.3%	14.7%	17.4%
ROIC	%	13.7%	-3.5%	-0.2%	4.6%	6.8%	7.7%

Source: Company data, Goldman Sachs Global Investment Research

We adopt SOTP as the primary valuation methodology for Dabeinong based on its comprehensive business lines, and potential new ventures into the GMO business. Our SOTP-based target price consists of:

- Rmb4.5/sh for GMO trait business, based on 40x 2027E P/E to price in the 1st generation ramp up of GMO commercialization, and
- Rmb0.5/sh for its conventional seed business, based on 30x of 2025E P/E (average of local peers before 2019 when GM rerating started), discounted to 2023E with of 9.5%; We reference Monsanto's PE range in 2005-2016, or 30-40x, as well as global peer Corteva's current trading range of 12-14x EV/EBITDA for the GM seeds valuation, based on 2027E earnings after the full launch of 1st generation GM seeds.
- Rmb7.9/sh for the feed business, based on 23x of 2025E P/E, discounted to 2023E with a discount rate of 9.5%, referring to the multiple of its domestic peers like Haid given their similar business exposure in the feed segment;
- Rmb0.5/sh for the hog business, based on 8x of 2025 P/E, discounted to 2023E with a discount rate of 9.5%, inline with its domestic peers like Wens and New Hope;
- Rmb0.3/sh for its animal and plant protection business, based on 20x of 2025 P/E based on the multiple of its local peers including Ringpu for animal drugs, and Yangnong Chemical ("扬农化工") (600486.SS) for herbicide and pesticide, discounted back to 2023E with a discount rate of 9.5%;
- Rmb0.1/sh, based on 10x of 2025E P/E for its minor business.

Accordingly, we derive a 12-month SOTP-based target price of Rmb13.6/sh (89% upside), implying 95x of 2023E P/E, 43x of 2024E P/E, and 35x 2025E P/E.

Exhibit 69: SOTP valuation - DBN

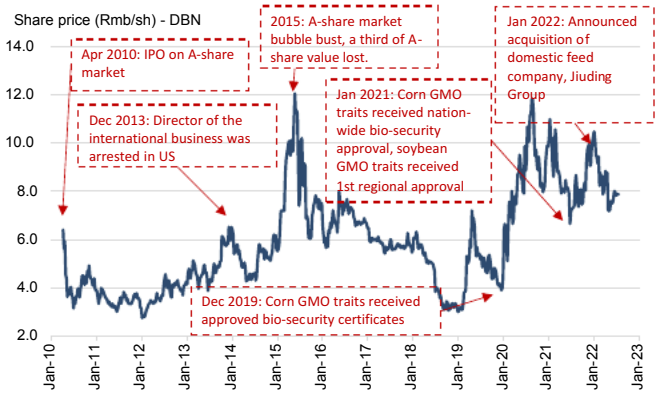
Valuations SOTP	EPS-25E Rmb/sh	EPS-27E Rmb/sh	Exit P/E x	Valuations Rmb/sh
Feed	0.409	n.a.	23 x	7.9
Hog	0.071	n.a.	8 x	0.5
Conventional seed	0.019	n.a.	30 x	0.5
GMO seed	0.054	0.160	40 x	4.5
Plant and animal protection	0.016	n.a.	20 x	0.3
Other	0.009	n.a.	10 x	0.1
Valuations	**0.578**	**1.027**		**13.6**

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 70: Forward P/E (x) - DBN

Source: Bloomberg, Company data, Goldman Sachs Global Investment Research

Exhibit 71: Share price - DBN



Source: Bloomberg, Company data, Goldman Sachs Global Investment Research

Key risks

1) Uncertainty in hog prices which can be affected by industry supply changes including both domestic supply and imports. Potential launch of ASF vaccine can have a material impact on both supply and costs, which may impact the demand recovery of swine feed.

2) Lower-than expected consumption demand on high-end hog products amid economy downturn and COVID-19 outbreaks.

3) Delayed timing on expansion projects, which could be negatively impacted by the company's cash management capability and overall supply/demand conditions.

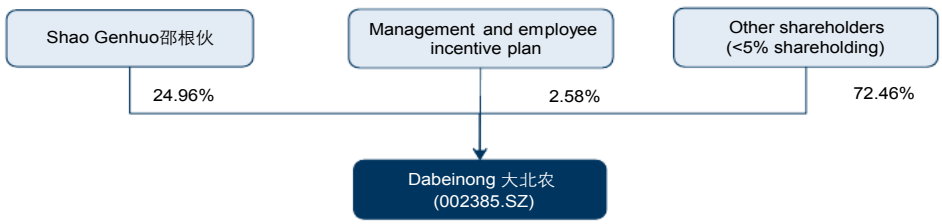
4) Slower-than-expected government approval of GM seed commercialization. Lower-than-expected GMO capture ratio in China may also limit the potential upside of net benefit for the company as a trait owner.

Company background - DBN

Dabeinong is the top diversified agriculture company active in the fields of swine feed, hog farming, crop protection and seed breeding, and animal health in China. In 2021, the company reported revenue of Rmb31.3bn, of which 72% was from feed, 15% from hog farming, 2% from seeds, and 1% from animal health (vaccines and drugs), and 1% from plant protection. Specifically, DBN sold 5.9mnt of feed in 2021A, holding over ~4% market share in swing feed, with focus more on high end feed for piglets and sows. DBN's efforts on seed breeding including GMO traits is prevailing versus peers - the company has received 5 bio-security traits approved by MOA by 1H22, and holds the most complete regional coverage in approvals of corn. Its DBN9004 trait has also received GMO bio-security license in both China and Argentina, making DBN the only commercial company with both corn and soybean GM products licensed with bio-security approval so far.

The company was founded by Dr. Shao Genhuo in 1994, after he resigned as a lecturer at Beijing University of Agriculture. It started as an animal nutrition company and became the No.1 player in pre-mix swine feed by the early 2000s. The company was listed on the Shenzhen Stock Exchange in 2010. Current shareholding structure is 25.0% by Mr Shao, 2.6% by management and employee incentive plan, and 72.5% by other shareholders.

Exhibit 72: Shareholding structure - DBN



Source: Company data, Goldman Sachs Global Investment Research

Key business segments

Feed is Dabeinong's main business that accounts for 72% of revenue and 82% of gross profit excl. the profit loss from hog segment. Within feed, swine feed is the biggest contributor with 78% volume, in which 40-50% of volume is from high-end products for piglets and sows, per our estimate. The company reported total feed sales of 5.9mnt and swine feed sales of 4.6mnt in 2021A, accounting for 2% and 3.5% of market share in China.

In hog farming, Dabeinong reported a loss of Rmb308mn in 2021A due to the price down cycle, compared to gross profit of Rmb1,990mn in 2021. The company also reported sales of 4.3mn heads by 2021A, of which 2.5mn heads came from its controlling farms and 1.8mn heads through its JV and associates. Based on management disclosure, DBN currently owns 11 breeding hog farms, and 100 hog farms nationwide in 2021A with an annual market hog capacity of 10mn heads and sow

capacity of 400k heads.

Seeds: In 2021, 56% of the seed sales was from rice seeds, and 41% of the seed sales was from corn seeds. The company started its GM seeds research since the establishment of its plant gene engineering research committee in 2021. The company reported total sales of 23.9kt in 2021A, up 26% yoy compared to 2020A.

Exhibit 73: Major subsidiaries and associates - DBN

Chinese	English	Interest %	Rev 2021 Rmb mn	NP 2021 Rmb mn
黑龙江大北农	Heilongjaing Dabeinong	44%	3,983	(1,003)
北京创种	Beijing Chuangzhong	100%	n.a.	n.a.
大北农生物技术	Dabeinong Biotech	70%	n.a.	n.a.

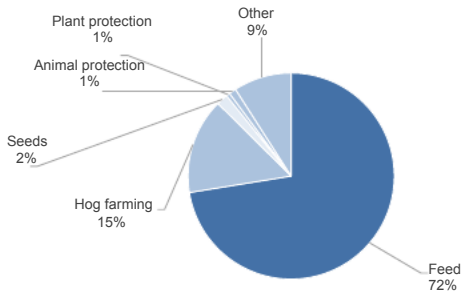
Source: Company data

Beijing Chuangzhong ("*北京创种*"), which operates in the seed and biotechnology business, is the company's newly integrated agricultural platform to cover the universe of farming business including corn, wheat, and soybean seed production and sales, biotechnology research, and GMO.

Heilongjiang Dabeinong ("*黑龙江大北农*") operates in the hog farming and feed business with a capacity of 3.5mn heads by 2020, of which the company owns 44% of total shares by end of 2021.

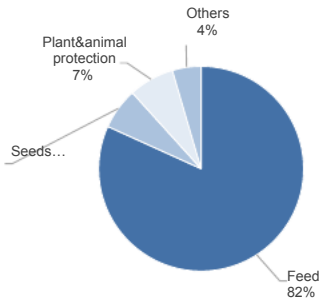
Dabeinong Biotechnology("*大北农生物技术*"), which mainly operates in GM seed development and research, is the major innovation center for the company's agricultural technology, which has received 4 bio-security licenses for corn traits and 1 bio-security license for soybean trait.

Exhibit 74: Revenue breakdown for 2021A - DBN



Source: Company data

Exhibit 75: Gross profit breakdown for 2021A - DBN



excl. gross loss of Rmb 308mn from hog segment in 2021A

Source: Company data

History and major events

1994: Shao Genhuo founded Dabeinong and launched first product of feed for piglets.

2001: Dabeinong set up seed breeding subsidiary with focus on rice and corn seed breeding. It appointed Professor Xu Qifeng as chief corn scientist, and Researcher

Zhang Huilian as chief rice scientist.

2002: Set up Dabeinong Animal Health and entered into animal drug business.

2003: Set up Fuzhou Dabeinong Bio-tech and entered into animal vaccine business.

2004: Its seed subsidiary started to set up on the ground breeding network across the country including Beijing, Sanya, Jilin, Henan, Hunan, Anhui, Jiangxi etc. It also set up production bases in Gansu, Xinjiang, Jiangsu, Fujian, and Hunan.

2010: The group was listed on the Shenzhen Stock Exchange.

2010: Set up a subsidiary Dabeinong Bio-tech and started to engage in R&D of GMO technology for crops.

2011: Completed and launched the world's biggest swine feed production line of 1mnt total capacity.

2012: Set up Dabeinong Hog Genetics subsidiary to engage in sow herd breeding.

2012: Announced a commitment to invest Rmb 500-800mn to build world-class R&D platforms for molecular breeding, genetic conversion, trait integration, and molecular markers. These platforms will focus on precision breeding and agronomic research of corn, rice, soybean.

2015: Set up two platforms in north-east China and Chiyang to directly engage in hog farming business

2017: Expanded the hog farming segments more broadly across the country by establishing new platforms in the south, north, north-west, east and Zhejiang.

2019: Dabeinong's GMO soybean seed received commercial license from Argentina government.

2020: Dabeinong's GMO corn seed received regional bio-safety license from China government.

2021: Dabeinong's GMO corn seed received national bio-safety license and its GMO soybean seed received extra regional bio-safety licenses.

Management profile

SHAO Genhuo, Chairman: Founder of the company, has a Ph.D. in Agronomy and was a lecturer at Beijing Agriculture University before setting up the company.

ZHANG Lizhong: president, joined the company in 1999, and has since worked in the company's feed segment. He has a bachelor's degree in animal nutrition from Nanjing Agriculture University.

SONG Weiping: vice president, joined the company in 2005 as vice president. He was previously vice president at Sichuan Husbandry and Veterinary Academy, and president at husbandry and veterinary research center of Beijing Agriculture, Forestry Academy.

Chen Zhongheng: vice president and board secretary, joined the company in 2000,

worked in the legal department before current role. Chen graduated from China University of Political Science and Law with major in Law, and has an MBA from Renmin University of China.

Wang Yuehua: vice president and CFO, joined the company in 1999, and has since worked as head of finance at multiple subsidiaries of the group. He has a bachelor degree in Economics from Taiyuan Technology University.

Denghai (002041.SZ, Neutral, 12-m TP: Rmb22.7/sh): Decelerating cyclical momentum, limited benefit of GM seeds

002041.SZ	12m Price Target: Rmb22.7	Price: Rmb20.33	Upside: 11.7%

Neutral

Market cap: Rmb17.9bn / $2.7bn
Enterprise value: Rmb17.9bn / $2.6bn
3m ADTV :Rmb348.2mn/ $51.8mn
China
China Agriculture
M&A Rank: 3
Leases incl. in net debt & EV?: Yes

GS Forecast

	12/21	12/22E	12/23E	12/24E
Revenue (Rmb mn)	1,100.7	1,671.8	1,975.9	2,266.1
EBITDA (Rmb mn)	238.0	363.1	428.2	494.0
EPS (Rmb)	0.26	0.39	0.46	0.54
P/E (X)	73.9	51.5	43.9	37.6
P/B (X)	5.6	5.3	4.8	4.3
Dividend yield (%)	0.2	0.4	0.5	0.5
N debt/EBITDA (ex lease,X)	(1.2)	(0.8)	(1.2)	(1.7)
CROCI (%)	10.2	10.0	10.8	11.3
FCF yield (%)	1.9	0.2	1.7	2.0

	6/21	12/21	6/22E	12/22E
EPS (Rmb)	0.12	0.15	0.14	0.25

Source: Company data, Goldman Sachs Research estimates, FactSet. Price as of 05 Aug 2022 close.

Initiate with Neutral: Denghai is one of the largest corn seed producers in China, with a unique long, established strength in corn germplasm seeds. We expect the company to benefit from the industry consolidation post the potential launch of 1st generation GM seeds, although the incremental benefit would be much smaller than for bio-tech traits owners. In the near term, we see decelerating cyclical momentum on corn seeds, with positive volume growth meet but muted margin expansions. We initiate coverage on Denghai with a Neutral rating and 12-month target price of Rmb22.7/sh, including Rmb16.0/sh from its conventional business and Rmb6.7/sh from GMO.

Limited benefit of GM seeds: Denghai is participating in the 1st generation of GM seeds by ingressing the bio-tech traits with its germplasm. Denghai has established a partnership with Dabeinong to collaborate on GMO corn development. We attribute the collaboration to be based on Denghai's biggest corn germplasm, brand recognition, and distribution network, which Dabeinong, as a trait developer lacks. We expect the commercial launch of GMO would translate to Rmb14-271mn of incremental profit for Denghai, or 2-18% of the total profit, equivalent to Rmb0.3-2.2/mu of incremental pricing on seeds during 2023E-2027E, assuming GMO penetration ramps up from 23% in 2023E to 90% in 2027E.

Decelerating cyclical momentum: With 6% of the market share by sales in conventional corn seeds, Denghai is benefiting from the cyclical recovery following the rise in corn price. However, we see decelerating cyclical momentum, as near-team margin improvement may be capped by a faster-than-expected supply response, and rising production cost. We expect the corn seeds sales volume to grow by 25% in 2022-25E, while margin to remain mostly flat.

Valuations and target price: Our valuation is based on SOTP, including 1) Rmb16.0/sh for conventional seeds; 2) Rmb 6.7/sh from GM seeds germplasm value. Our TP implies P/E of 49x on 2023E, P/E of 42x on 2024E, and P/E of 37x on 2025E in our base, non

GMO case.

Key risks: 1) Faster or slower-than-expected government approval of GM seed commercialization. 2) Lower-than-expected GMO capture ratio in China to limit the potential upside at germplasm and distributor level. 3) Increasing seed production cost to pressure margin outlook, offsetting the improving pricing strength.

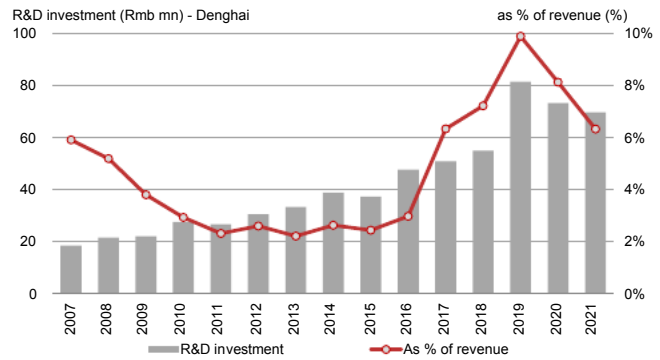
Limited benefit from 1st generation GM seeds, LT value of strong germplasm remains

We see the long term position of the germplasm industry position as attractive, although its near-term upside from the 1st generation GM seeds is limited due to the low capture rate in a still fragmented market, which now has over 1100 corn seed producers nationwide. Among the benefits of GMO commercialization distributed to local seed players, we expect 20% to be shared among germplasm owners like Denghai, half the size of the net benefit for trait companies. It is noteworthy that Denghai has established a partnership with Dabeinong to collaborate on GMO corn development. According to management, the company's best-selling corn variety DH605 ("登海605") has imported Dabeinong's insect resistance traits successfully in 2021A, which now has an annual planting area of 8-10mn mu nationwide and is expected to start pre-sales during the next summer planting season in 2023.

In the long-term, we expect Denghai to benefit from its top-tier germplasm resources, and it is uniquely positioned as the largest crop seed breeder in China, and a clear beneficiary of the country's tightening IP protection. Accordingly, we highlight:

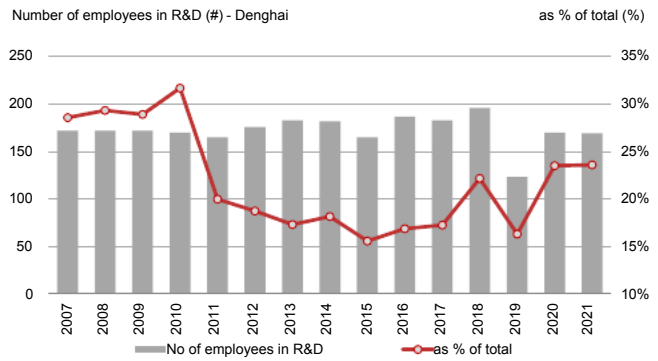
Germplasm resource is the key. Denghai reported 58.7kt of corn seed sales in the 2020/2021 planting year, leading in both volume and sales versus local peers. Its two most popular corn products DH605 and XY335 ("先玉335"), have been ranked Top 10 best-selling corn seed by MOA during the 2020/2021 planting year, totaling 20mn mu of planting area, or an equivalent 13kt of seed sales by our estimate. We believe the company's ability to ingress GMO into its existing germplasm, as well as the potential evolution of new germplasm species given the usage of advanced molecular breeding in recent years, could help Denghai to regain a higher market share from low quality producers. In the long run, we see Denghai's specialization in corn product and accumulated germplasm reserve are central to driving its future earnings, which would translate to Rmb295-343mn of net benefit from 2028E onward.

Exhibit 76: R&D investment - Denghai



Source: Company data

Exhibit 77: Number of employees in R&D - Denghai

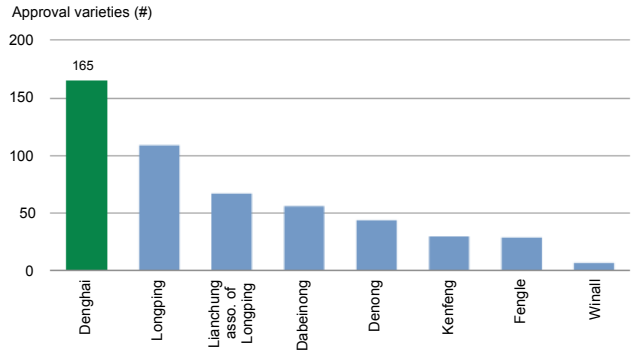


Source: Company data

New seed law to encourage heterogeneous IP. The roll-out of the new seed law reflects a material expansion in domestic breeders' rights, with the introduction of the concept of "essentially derived variety" (EDVs) (实质型派生品种) to distinguish those originally developed varieties from homogeneously derived ones. We see the government's

impetus to encourage original IP, coupled with stringent measures for approving new varieties, would reinforce the company's leading position in the domestic corn sector going forward. Denghai has received 165 new corn variety licenses during 2010A-2021A, ahead of all its domestic peers given its years-long R&D commitment and high-quality germplasm resources that in particular, contain lodging resistance and early maturing genotypes.

Exhibit 78: Denghai received the most # of national corn variety resgistrations among all private breeders

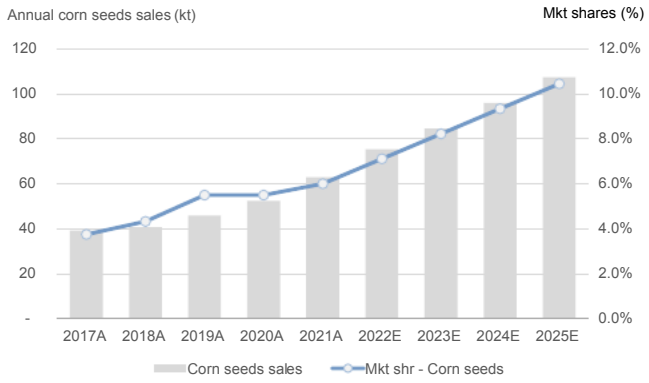


Source: MOA, Company data, Data compiled by Goldman Sachs Global Investment Research

Decelerating cyclical momentum

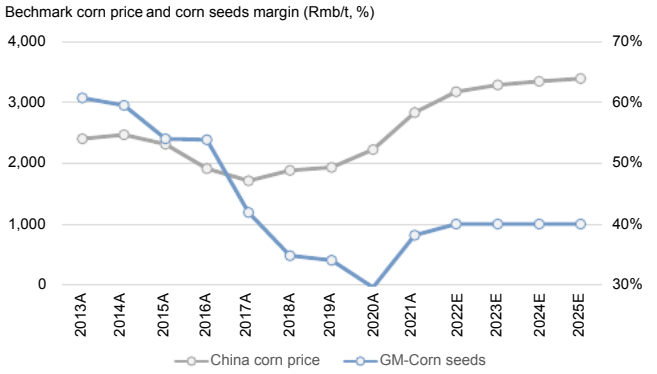
We expect Denghai to stand out in a consolidating seed market, although its near-team margin improvement may be capped by a faster-than-expected supply response, and increasing production cost. According to management, total corn seed production is expected to grow 20% yoy in 2022E, while production cost has increased from Rmb3,200-3,300/mu in 2021A to Rmb4,000/mu in 2022E, equivalent to Rmb2/kg, which partially offsets the price upturn. In our base, non-GMO case, we estimate Denghai's corn seed ASP to increase 14% yoy to Rmb20.3/kg in 2022E, while slowing down to a 3% CAGR from 2023E to 2025E due to decelerating cyclical momentum. Nevertheless, the accelerating GMO penetration would reinforce the company's leading position in seed breeding, underpinning its margin sustainability with volume growth. We expect the company's market share by sales to increase from ~6% in 2021A to 10% in 2025E, 13% in 2027E, and 16% in the LT, driven by its high-quality germplasm resource, and tightening partnership with top trait owners.

Exhibit 79: Annual corn seeds sales and market share - Denghai



Source: MOA, Company data, Goldman Sachs Global Investment Research

Exhibit 80: Corn seeds margin vs. Benchmark corn price - Denghai (Base case scenario)



Source: Bloomberg, Wind, Company data, Goldman Sachs Global Investment Research

Financials and valuations - Denghai

Note: Our base case earnings do not include GM earnings pending the official launch of GM seeds commercialization. But we have included the GM impact in valuations and target price, taking a forward-looking approach.

We initiate on Denghai with a Neutral rating and 12m target price of Rmb22.7/sh, implying 12% upside. We expect the company to deliver top line growth of 24% during 2022E-2025E, driven by increasing market share, and GMO net benefit as a top germplasm owner. Accordingly, we highlight:

Corn segment: we expect Denghai's corn segment to deliver a 14% CAGR in volume, and 25% CAGR in revenue during 2022E-2025E, driven by continuing market share gain and improving ASP. In our base, non-GMO case, we expect corn margin to stay at 40% during 2022E-2025E.

Wheat and vegetable seeds: We expect Denghai's wheat selling price to improve with a 5% CAGR during 2022E-2025E, while sales volume stays flat.

We expect Denghai's recurring net profit to go up by 15-65% yoy in 2022E-2025E, driven by continuing market share gain and improving margin. The recurring net profit is expected to reach Rmb347mn in 2022E, Rmb407mn in 2023E, and Rmb475-545mn in 2024E-2025E, which is 4-28% lower than consensus in our base, non GMO case. We see margin for corn seed to stay at 40%, and 15% for wheat seed in 2022-25E, as higher pricing should offset the increasing production cost.

Looking forward, we expect Denghai to maintain its current debt structure, and stay in a net cash position in 2022-25E with steady operating cash inflow. Denghai will continue its investment in germplasm, leading to CAPEX of Rmb50-76mn in 2022E-2025E.

In terms of shareholder's return, we expect Denghai's ROEs to improve, from 11% in 2022E, to 12-13% in 2023E-2025E, versus 8% in 2021A. From 2022E onward, we see Denghai's dividend payout to stay constant at 20%, compared with 14% in 2021A, and 30% in 2019A.

Exhibit 81: Key assumptions and financials - Denghai (base case scenario)

Key assumptions and financials							
		2020A	2021A	2022E	2023E	2024E	2025E
Benchmark spot price (China)							
China corn price	Rmb/t	2,224	2,835	3,180	3,291	3,350	3,395
Corn seeds sales	kt	52.3	62.8	75.4	84.5	95.9	107.3
Mkt shr - Corn seeds	%	5.5%	6.0%	7.1%	8.2%	9.3%	10.4%
Wheat seeds sales	kt	14.7	15.4	15.4	15.4	15.4	15.4
Mkt shr - Wheat seeds	%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%
Vegetables seeds sales	kt	0.2	0.2	0.2	0.2	0.2	0.2
ASP-Corn seeds, fundamental	Rmb/kg	15.0	17.8	20.3	21.5	21.9	22.1
ASP-Wheat seeds	Rmb/kg	3.9	3.9	4.1	4.7	4.8	4.8
ASP-Vegetable seeds	Rmb/kg	83.7	79.3	88.2	90.8	93.5	96.4
Revenue-total	Rmb mn	901	1,101	1,672	1,976	2,266	2,546
Rev-Corn seeds total	Rmb mn	785	978	1,530	1,819	2,101	2,372
Rev-wheat seeds/ vegetables seeds/ others	Rmb mn	116	122	142	157	166	175
Gross profit-total	Rmb mn	259	400	645	764	879	991
GP-Corn seeds, fundamentals	Rmb mn	232	373	612	727	840	949
GP-GMO value to germ owners	Rmb mn	-	-	-	-	-	-
GP-Wheat seeds/ vegetable seeds/ others	Rmb mn	28	26	33	37	39	42
Gross margin-overall	%	29%	36%	39%	39%	39%	39%
GM-Corn seeds	%	30%	38%	40%	40%	40%	40%
GM-Wheat seeds	%	17%	17%	15%	15%	15%	15%
GM-Vegetable seeds	%	51%	51%	50%	50%	50%	50%
GM-Others	%	23%	18%	24%	24%	24%	25%
R&D investment	Rmb mn	73	70	100	119	136	153
As % of revenue	%	8%	6%	6%	6%	6%	6%
No of employees in R&D	#	170	169	n.a.	n.a.	n.a.	n.a.
EBIT-recurring	Rmb mn	67	191	356	421	486	551
EBITDA-recurring	Rmb mn	141	257	423	488	554	620
Net Profit	Rmb mn	102	233	347	407	475	545
Net Profit-recurring	Rmb mn	114	210	347	407	475	545
EPS	Rmb/sh	0.116	0.265	0.395	0.463	0.540	0.619
EPS-recurring	Rmb/sh	0.129	0.239	0.395	0.463	0.540	0.619
Operating cash flow	Rmb mn	369	365	93	362	438	513
Investing cash flow	Rmb mn	(252)	(299)	(50)	(59)	(68)	(76)
Free cash flow	Rmb mn	359	334	43	303	370	437
Net debt	Rmb mn	(259)	(289)	(300)	(534)	(822)	(1,164)
Net debt/Equity	%	net cash	net cash	net cash	net cash	net cash	net cash
FCF	Rmb/sh	0.41	0.38	0.05	0.34	0.42	0.50
BV	Rmb/sh	3.28	3.51	3.87	4.26	4.70	5.21
ROE	%	3.6%	7.8%	10.7%	11.4%	12.1%	12.5%
ROE recurring	%	4.0%	7.0%	10.7%	11.4%	12.1%	12.5%
ROIC	%	1.2%	6.3%	9.7%	10.5%	11.0%	11.3%

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 82: Key assumptions and financials - Denghai (GMO case scenario)

Key assumptions and financials							
		2020A	2021A	2022E	2023E	2024E	2025E
Benchmark spot price (China)							
China corn price	Rmb/t	2,224	2,835	3,180	3,291	3,350	3,395
Corn seeds sales	kt	52.3	62.8	75.4	84.5	95.9	107.3
Mkt shr - Corn seeds	%	5.5%	6.0%	7.1%	8.2%	9.3%	10.4%
Wheat seeds sales	kt	14.7	15.4	15.4	15.4	15.4	15.4
Mkt shr - Wheat seeds	%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%
Vegetables seeds sales	kt	0.2	0.2	0.2	0.2	0.2	0.2
ASP-Corn seeds, fundamental	Rmb/kg	15.0	17.8	20.3	21.5	21.9	22.1
ASP-Wheat seeds	Rmb/kg	3.9	3.9	4.1	4.7	4.8	4.8
ASP-Vegetable seeds	Rmb/kg	83.7	79.3	88.2	90.8	93.5	96.4
Revenue-total	Rmb mn	901	1,101	1,673	1,990	2,310	2,642
Rev-Corn seeds total	Rmb mn	785	978	1,530	1,819	2,101	2,372
Rev-wheat seeds/ vegetables seeds/ others	Rmb mn	116	122	142	157	166	175
Gross profit-total	Rmb mn	259	400	646	778	923	1,086
GP-Corn seeds, fundamentals	Rmb mn	232	373	612	727	840	949
GP-GMO value to germ owners	Rmb mn	-	-	1	14	44	96
GP-Wheat seeds/ vegetable seeds/ others	Rmb mn	28	26	33	37	39	42
Gross margin-overall	%	29%	36%	39%	39%	40%	41%
GM-Corn seeds	%	30%	38%	40%	40%	41%	42%
GM-Wheat seeds	%	17%	17%	15%	15%	15%	15%
GM-Vegetable seeds	%	51%	51%	50%	50%	50%	50%
GM-Others	%	23%	18%	24%	24%	24%	25%
R&D investment	Rmb mn	73	70	100	119	139	159
As % of revenue	%	8%	6%	6%	6%	6%	6%
No of employees in R&D	#	170	169	n.a.	n.a.	n.a.	n.a.
EBIT-recurring	Rmb mn	67	191	357	433	522	629
EBITDA-recurring	Rmb mn	141	257	424	500	590	699
Net Profit	Rmb mn	102	233	348	419	512	625
Net Profit-recurring	Rmb mn	114	210	348	419	512	625
EPS	Rmb/sh	0.116	0.265	0.396	0.476	0.581	0.710
EPS-recurring	Rmb/sh	0.129	0.239	0.396	0.476	0.581	0.710
Operating cash flow	Rmb mn	369	365	94	374	473	592
Investing cash flow	Rmb mn	(252)	(299)	(50)	(60)	(69)	(79)
Free cash flow	Rmb mn	359	334	44	314	404	513
Net debt	Rmb mn	(259)	(289)	(301)	(545)	(866)	(1,277)
Net debt/Equity	%	net cash	net cash	net cash	net cash	net cash	net cash
FCF	Rmb/sh	0.41	0.38	0.05	0.36	0.46	0.58
BV	Rmb/sh	3.28	3.51	3.87	4.27	4.76	5.35
ROE	%	3.6%	7.8%	10.7%	11.7%	12.9%	14.1%
ROE recurring	%	4.0%	7.0%	10.7%	11.7%	12.9%	14.1%
ROIC	%	1.2%	6.3%	9.7%	10.7%	11.7%	12.6%

Source: Company data, Goldman Sachs Global Investment Research

We adopt SOTP as the primary valuation methodology for Denghai based on top-line improvement driven by market consolidation, and potential GMO value gain arising from its high-quality corn germplasm resources. Our SOTP-based target price consists of:

- Rmb6.7/sh for GMO trait business, based on 40x 2027E P/E to price in the 1st generation ramp up of GMO commercialization, and
- Rmb16.0/sh for its conventional seed business, based on 30x of 2025E P/E (average of local peers before 2019 when GM rerating started), discounted back to 2023E with a discount of 9.5%;
- We reference Monsanto's PE range in 2005-2016, or 30-40x, as well as global peer Corteva's current trading range of 12-14x EV/EBITDA for the GM seeds valuation, based on 2027E earnings after the full launch of its 1st generation GM seeds.

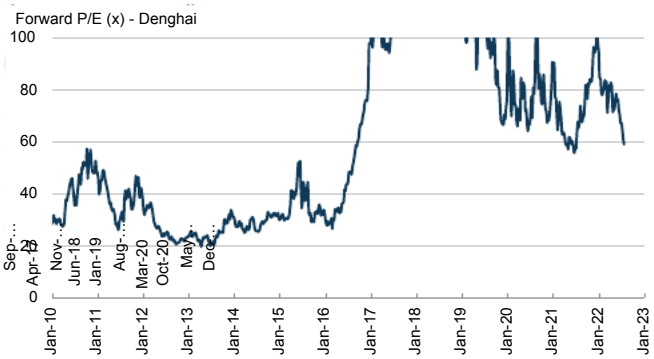
Accordingly, we derive a 12-month SOTP-based target price of Rmb22.7/sh (12% upside), implying 57x 2022E P/E and 49x 2023E P/E, and 37-42x P/E during 2024E-2025E.

Exhibit 83: SOTP Valuation - Denghai

Valuations SOTP	EPS 25 Rmb/sh	EPS 27 Rmb/sh	Exit P/E x	Valuations Rmb/sh
Conventional seed	0.639	n.a.	30 x	16.0
GMO	0.072	0.241	40 x	6.7
Valuation/share	0.710	1.034		22.7

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 84: Forward P/E - Denghai



Source: Bloomberg, Company data, Goldman Sachs Global Investment Research

Exhibit 85: Share price - Denghai

Source: Bloomberg, Company data, Goldman Sachs Global Investment Research

Key Risks

1) Faster or slower-than-expected government approval of GM seed commercialization, which may create uncertainty for the company's business model and profit split on germplasm sharing.

2) Lower-than-expected GMO capture ratio in China to limit the potential upside at germplasm and distributor level, and slow the market consolidation given low quality producers would maintain regional advantage without GMO penetration.

3) Increasing seed production cost to pressure margin outlook, offsetting the improving

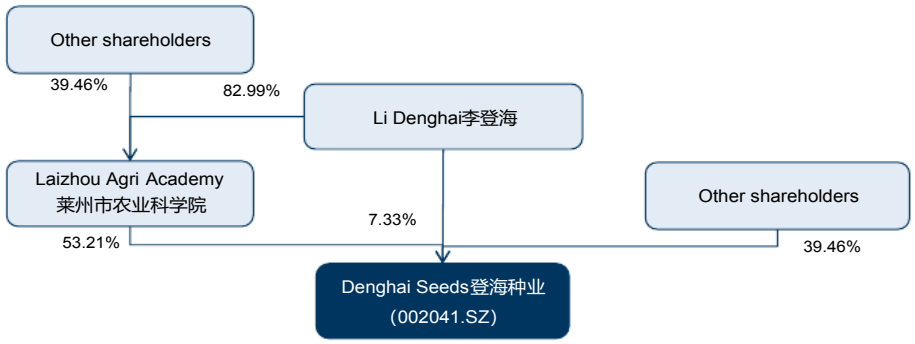
pricing strength.

Company background - Denghai

Denghai was founded by China's most reputable corn breeder Li Denghai in 1998. Before the inception of the company, Li Denghai had been the primary researcher for the corn breeding program under Laizhou Agri Academy since 1985, in which he later turned into the major shareholder of the company. Denghai's proprietary product DH-series, and co-developed product XY-335, have been ranked among the Top 10 best-selling corn seed products in China by the MOA with a planting area of ~20mn mu or an equivalent 1.3mn ha during 2020/2021 planting year.

Denghai owns one of the largest corn germplasm resources in China - it received 165 national corn varieties registrations from 2010 to 2021A, ranking No.1 among all seed companies. Denghai's corn seed products are widely recognized for their continued evolution and yield improvement, repeated set field testing record for yield improvement, which is supported by the company's years long R&D commitment and partnership with leading research institutions. As of 2021A, the company has received a total of 170 variety licenses, with 5 of its products ranked in the Top 20 best-selling corn products by China Seed Association during 2020/2021 planting year.

Exhibit 86: Shareholding structure in 2021A - Denghai

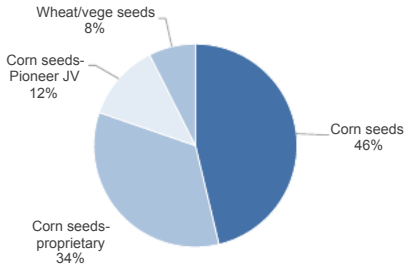


Source: Company data, Goldman Sachs Global Investment Research

Key business segments

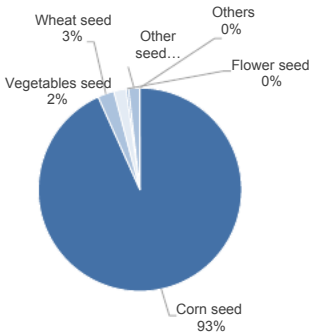
The company's main business is in the sales and production of seeds, with corn seeds accounting for ~90% of its revenue and gross profit, other products include wheat and vegetable seeds. Currently, Denghai's corn seeds are sold under both Denghai's proprietary brands and JV with Pioneer, in which Denghai owns a 51% stake.

Exhibit 87: Revenue breakdown 2021A - Denghai



Source: Company data

Exhibit 88: Gross profit 2021A - Denghai



Source: Company data

Denghai Xianfeng ("登海先锋"), mainly operates in the production of corn seeds, which is jointly established with Pioneer Seed, a leading GMO seed producer currently under the umbrella of Corteva (CTVA).

Denghai Liangyu ("登海良玉"), mainly operates in the production, processing, and sales of corn seeds.

Denghai Huayu ("登海华玉"), mainly operates in the breeding, processing, packaging, and sales of corn seeds.

Denghai Wuyue ("登海五岳"), mainly operates in the breeding and sales of wheat and corn seeds.

Denghai Daoji, ("登海道吉"), mainly operating in the sales, production and R&D of hybrid corn seeds.

Exhibit 89: Major associates and subsidiaries - Denghai

Chinese	English	Interest %	Rev 2021 Rmb mn	NP 2021 Rmb mn
登海先锋	Denghai Xianfeng	51%	260	17
登海良玉	Denghai Liangyu	51%	4	(13)
登海华玉	Denghai Huayu	68%	47	4
登海五岳	Denghai Wuyue	51%	89	4
登海道吉	Denghai Daoji	51%	50	6

Source: Company data, Goldman Sachs Global Investment Research

History and major events

1985: Li Denghai set up Laizhou Agriculture Academy and led the corn breeding program under the academy

1998: Denghai Seeds was established to operate the breeding program under a commercial entity

2002: Denghai Seeds set up a joint venture with Pioneer Seeds from the US to collaborate on corn breeding for the domestic China market.

2005: Launched "XY 335" corn seed under Denghai-Pioneer JV, that later became one of the most successful corn seeds ever sold in the China market.

2005: listed on Shenzhen Stock Exchange.

2013: "DH 618" corn seed broke the national yield record for both spring and summer planting.

2013: founder Li Denghai retired as chairman.

2020: "DH3719" broke world summer planting maize yield record by 28%.

2021: company confirmed it has engaged in R&D and testing of GMO technology with Dabeinong.

Management profile

YAN Lixiang: general manager, joined the company in 2002, he has since worked on multiple sales and marketing roles at the company.

YUAN Shaogang: deputy general manager and board secretary, joined the company in 2007 as board secretary. Before joining Denghai, he worked as assistant general manager at a mining company.

CHENG Li: deputy general manager, joined the company since inception, he had since worked on multiple sales and marketing roles at the company.

Deng Li: CFO, joined the company since inception, she has since worked on multiple accounting and finance roles at the company.

Longping (000998.SH, Sell, 12-m TP: Rmb12.5/sh): Recovery muted in rice seeds, decelerating efforts on GM seeds

000998.SZ	12m Price Target: Rmb12.5	Price: Rmb15.12	Downside: 17.3%

Sell

Market cap: Rmb19.9bn / $2.9bn
Enterprise value: Rmb24.6bn / $3.6bn
3m ADTV :Rmb371.1mn/ $55.3mn
China
China Agriculture
M&A Rank: 3
Leases incl. in net debt & EV?: No

GS Forecast

	12/21	12/22E	12/23E	12/24E
Revenue (Rmb mn)	3,503.4	3,798.7	4,383.9	4,744.1
EBITDA (Rmb mn)	494.0	618.3	767.8	952.9
EPS (Rmb)	0.05	(0.05)	0.11	0.19
P/E (X)	NM	NM	140.5	77.9
P/B (X)	4.7	3.7	3.6	3.4
Dividend yield (%)	0.0	0.0	0.2	0.4
N debt/EBITDA (ex lease,X)	104.8	6.1	5.3	4.3
CROCI (%)	8.6	7.4	8.7	9.9
FCF yield (%)	3.5	(1.2)	(1.2)	(0.0)
	9/21	**12/21**	**--**	**--**
EPS (Rmb)	0.09	0.05	--	--

Source: Company data, Goldman Sachs Research estimates, FactSet. Price as of 05 Aug 2022 close.

Downgrade to Sell: We revise down Longping's earnings by 37-126% for 2022E-2024E to incorporate lower margin assumptions for both corn and rice seeds, as a result of market share gain and competition, amid cost inflation. We remain positive on the outlook for the potential introduction of corn GM seeds in the domestic market, yet we see lower economic benefits for Longping versus its major peers given its decelerating efforts, as reflected in its lower share of Longping Bio-Tech ("隆平生物") and declining R&D spending. We downgrade the stock to Sell with a revised target price of Rmb12.5 (from Rmb14.2/sh), implying 17% downside to the current price, vs. coverage average return potential of 18%.

Decelerating efforts in GM seeds: We see potential GM seed introduction benefiting Longping's traits business through its subsidiaries Longping Bio-Tech and Hangzhou Ruifeng ("杭州瑞丰"), and germplasm on hand. Nevertheless, the recent change in the company's shareholdings in its key subsidiaries, as well as lower R&D spending, may reflect decelerating efforts in GM seeds. We see Longping's divestment from its most important bio-tech subsidiary as a signal of its slow GMO movement, and therefore we assign lower upside to Longping's potential trait value gain, expecting Rmb12-206mn from the trait franchise, mostly from sharing with Ruifeng, and Rmb16-293mn from germplasm sharing during 2023E-2027E, down 64% from our previous estimate. Nevertheless, we still value Longping as a major stakeholder of GMO commercialization, expecting Ruifeng to capture 15%-30% of market share in the domestic corn trait market during 2023E-2027E.

Recovery muted in rice seed, cost pressure in corn: In traditional seeds, we estimate strong growth in corn seeds in 2022E, yet earnings momentum is likely to decelerate, as seed supply is moving up while costs also increase. We estimate Longping will maintain its unit profit in corn seeds, through moderate price hikes of 5-6%. On the other hand, recovery in rice seeds still looks remote, given the relative underperformance of rice prices (-2% yoy) vs other major grains (18-20% in soybean

and wheat). As of 1H22, the company also disclosed an extraordinary fx loss of Rmb144mn from its offshore USD loans, and an additional Rmb61mn of JV/associate investment loss from its Brazil operation, according to its profit alert.

Valuation and target price: Our revised SOTP based 12-m target price of Rmb12.5/sh for Longping includes Rmb9.1/sh for conventional seeds, and Rmb3.4/sh from potential GMO upside. Our TP implies a P/E of 116x on 2023E earnings, 64x on 2024E earnings, and 42x on 2025E earnings, in a non-GMO base case.

Key risks - 1) Faster than-expected government approval of GM seed commercialization, which is the biggest swing factor for Longping's valuation; 2) The hybrid rice cycle may turn around faster-than-expected; and 3) a faster-than-expected recovery and turnaround of the Brazil business, which is still uncertain with ongoing transition and turnaround efforts.

Decelerating efforts in GM seeds

We see potential GM seed introduction benefiting Longping's traits business through its subsidiaries Longping Bio-Tech ("隆平生物") and Hangzhou Ruifeng ("杭州瑞丰"), and germplasm on hand. Nevertheless, the recent reduction in the company's shareholdings in key subsidiaries, as well as lower R&D spending, may reflect decelerating efforts in GM seeds. In June 2021, Longping announced a strategic private placement plan to introduce China Rural Area Industrial Investment Fund (中央企业乡村产业投资基金), managed by State Development & Investment Corp., Ltd. ("国投") as the largest shareholder for Longping Bio-Tech. Post acquisition, Longping would no longer consolidate the subsidiary as a result of reducing its shareholding from 52% to 18%. Nevertheless, we still value Longping as a major stakeholder of GMO commercialization, expecting Ruifeng to capture a 15%-30% share of the domestic corn trait market during 2023E-2027E. In the meantime, Longping is also collaborating with other major traits owners, and has completed its transgenic breeding based on its germplasm for its major products.

As of now, Ruifeng has already received GMO bio-security licenses for 3 corn trait products, accounting for ~20% of total approved traits in China. The three corn traits include Ruifeng 125, Ruifeng 8 and nCX-1 as a refuge. Specifically:

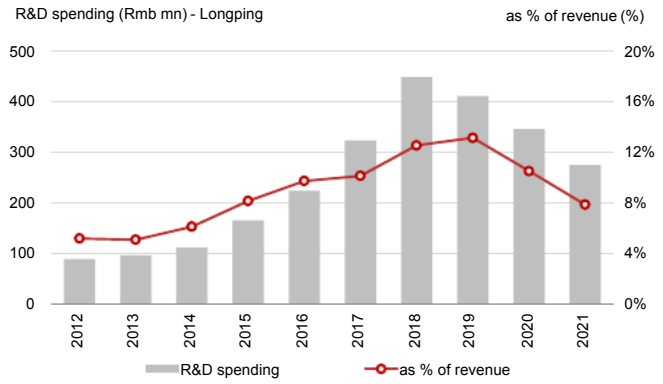
- Ruifeng 125 is a stacked trait product proved to be 90-100% effective against Asian corn borer, bollworm, and arymworm, and can tolerate up to 4x use of glyphostate and glufosinate given its embedded herbicide-tolerance **g10eve-epsps** genotype, which is allowed to be further examined in the corn regions of Southwest China.
- Ruifeng 8 is an insect resistance trait product proved to be highly effective against Asian corn borer, armyworm, and bullworm, which is allowed to be further examined in the corn regions of South China.
- nCX-1 is a refuge corn product with license approved in April 2022, which is allowed to be further examined in the corn regions of South China.

Exhibit 90: GMO economics - Longping

Corn		2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E/LT
Industry-GMO Penetration	%	0%	5%	23%	41%	59%	77%	90%	90%	90%	90%
Industry-GMO value addition	Rmb mn	-	94	871	2,357	4,575	7,550	10,711	10,711	10,711	10,711
Industry-Germplasm improvement TAM	Rmb mn	-	-	-	-	-	-	-	3,090	6,246	11,847
Industry-GMO value shares to traits	%	0.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Industry-GMO value shares to germpla	%	0.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
LP-GMO mkt shr, corn	%	0.0%	15.0%	15.0%	15.0%	15.0%	17.8%	20.7%	23.5%	26.4%	29.2%
LP-Conventional mkt shr, corn	%	7.0%	8.1%	9.2%	10.3%	11.4%	12.6%	13.7%	14.8%	15.9%	17.0%
LP-GMO-value to trait owners	Rmb mn	-	1	12	33	64	125	206	234	262	291
LP-GMO-value to germ owners	Rmb mn	-	2	16	49	105	190	293	317	340	364

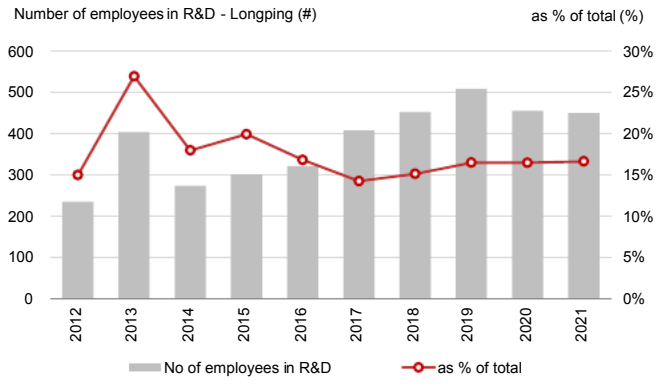
Source: MOA, ISAAA, Wind, Company data, Goldman Sachs Global Investment Research

Exhibit 91: R&D investment - Longping



Source: Company data, Data compiled by Goldman Sachs Global Investment Research

Exhibit 92: Number of employees in R&D - Longping



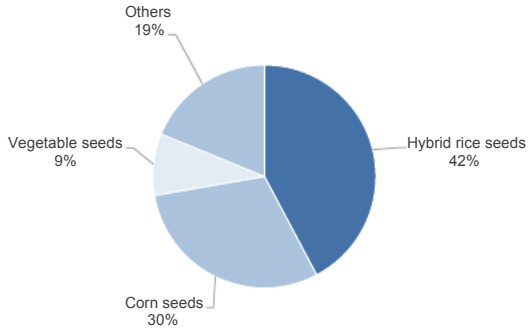
Source: Company data, Data compiled by Goldman Sachs Global Investment Research

Traditional seeds - higher ASP offset by cost in corn, lack of recovery in rice

In traditional seeds, we estimate strong growth in corn seeds in 2022E, yet earnings momentum is likely to decelerate, as seed supply is moving up while costs also increase. For 2022E, management expect a 10~25% increase in market corn price, from Rmb40/package to Rmb45-50/package, or an equivalent ~Rmb4-7/kg of price increase, of which 60% would be attributed to Longping itself. We estimate Longping will maintain its unit profit in corn seeds, through moderate price hikes of 5-6% going forward. On the other hand, recovery in rice seeds still looks remote, given the relative underperformance of rice prices (-2% yoy) vs other major grains (18-20% in soybean and wheat). As of 1H22, the company also disclosed an extraordinary fx loss of Rmb144mn from its offshore USD loans, and an additional Rmb61mn of JV/associate investment loss from its Brazil operation, according to its profit alert.

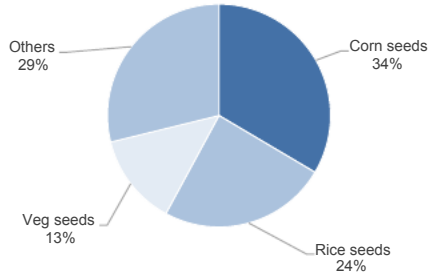
On a five-year outlook, Longping targets to reach Rmb5bn sales by the end of China's 14th Five-Year Plan with its market share of corn seeds in the domestic market to reach 15% by 2025 from the current ~7% level, underpinned by incremental demand from its previously non-core sales regions like NE China. In the long term, we expect Longping's corn seed ASP to increase from Rmb16.4/kg to Rmb18.7-20.4/kg during 2022E-2025E, and rice ASP to decline from Rmb37.3/kg to Rmb36.6/kg in 2022E, and to grow at a moderate 5% CAGR thereafter.

Exhibit 93: Revenue mix - Longping in 2022E (base case scenario)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 94: Gross profit breakdown in 2022E - Longping (base case scenario)



Source: Company data, Goldman Sachs Global Investment Research

Financials and valuations - Longping

Note: Our base case earnings estimates do not include GM earnings pending the official launch of GM seeds commercialization. However, we have included the GM impact in valuations and target price, taking a forward-looking approach.

We downgrade Longping to Sell with a revised 12m target price of Rmb12.5/sh (previously Rmb14.2) implying 17% downside, given the company's slowing GMO input and increasing production cost. Accordingly:

We expect the company's corn segment to deliver a 15% CAGR in volume and 10% CAGR in revenue during 2021A-25E, driven by consolidating market share and improving ASP, which is expected to grow at a 6% CAGR during the same period, from Rmb16.4/kg to Rmb20.4/kg. We expect the company's conventional corn seed business to report gross profit of Rmb467-775mn with a margin level of 35-36% during 2022E-2025E. We also expect a GMO net benefit of Rmb16-293mn from the company's germplasm ownership, and Rmb12-206mn of trait benefit through its equity investment in Ruifeng during 2022E-2025E.

For the rice segment, we expect intensifying competition to pressure selling prices in the near term, down 2% yoy in 2022E, rebounding by 10% yoy in 2023E to Rmb39/kg, then growing at 5% yoy going forward. We expect the company's rice seed business to report gross profit of Rmb340-508mn with margin levels of 28-34% during 2022E-2025E.

Assuming no GMO contribution, in our base case we expect Longping to report net recurring profit of Rmb153-396mn net profit during 2022E-2025E, which is 59-70% below Bloomberg consensus. We believe our estimates differ from consensus due to the company's rising production cost and lack of recovery in its rice segment, which accounted for 35% of total profit in 2021A. On the margin front, we expect the gross margin to improve from 31% in 2021A to 35-36% in 2023E-2025E (36%-41% on GMO basis) for corn seed, 28%-34% for rice seed, 60% for vegetables seeds, and 43%-44% for others. Overall margin is expected to be 37%-39% during 2023E-2025E, or 38%-41% including a GMO contribution, with an incremental profit of Rmb28-169mn from GMO ramp up.

Additionally, we expect Longping's CAPEX to grow from Rmb430mn in 2021A, to Rmb467-629mn during 2022E-2025E, with net gearing ranging from 40-46%. We expect the company to report a negative cash flow of Rmb4-247mn during 2022E-2024E, and positive cash flow of Rmb136mn in 2025E. We also see the company starting to pay dividends from 2023E when earnings turn positive with a dividend payout ratio of 30%. Longping did not declare any dividend during 2020A-2021A.

In February 2022, Longping announced its new batch of share incentive plan, targeting to reach 60%-240% yoy sales growth, or 5-15% yoy net profit growth during 2022E-2024E, which would translate into Rmb15-100mn of additional administration expenses during 2022E to 2025E, according to the company's announcement.

Exhibit 95: Key assumptions and financials - Longping (base case scenario)

Key assumptions and financials							
		2020A	2021A	2022E	2023E	2024E	2025E
Benchmark prices							
China corn price	Rmb/t	2,224	2,835	3,180	3,291	3,350	3,395
Corn seeds sales	kt	63.6	61.8	71.0	83.1	94.3	105.6
Mkt shr - Corn seeds	%	6%	7%	8%	9%	10%	11%
GMO penetration-corn	%	0%	0%	5%	23%	41%	59%
Rice seeds sales	kt	39.8	34.9	33.2	34.9	35.2	35.6
Mkt shr - rice seeds	%	7%	8%	7%	7%	7%	8%
Vegetables seeds sales	kt	0.2	0.2	0.2	0.2	0.2	0.2
ASP-Corn seeds, fundamental	Rmb/kg	15.5	16.4	18.7	19.9	20.2	20.4
ASP-Rice seeds	Rmb/kg	35.0	37.3	36.6	40.2	40.8	42.0
ASP-Vegetables seeds	Rmb/kg	1,575	1,533	1,582	1,628	1,678	1,728
Revenue-total	Rmb mn	3,291	3,503	3,799	4,384	4,744	5,117
Revenue-Corn seeds	Rmb mn	988	1,015	1,330	1,651	1,906	2,152
Revenue-Rice seeds	Rmb mn	1,390	1,304	1,214	1,402	1,435	1,494
Revenue-Vegetables seeds	Rmb mn	294	287	311	336	363	393
Revenue-Others	Rmb mn	618	898	944	995	1,039	1,078
Gross profit-total	Rmb mn	1,270	1,201	1,393	1,640	1,812	1,992
GP-Corn seeds, fundamentals	Rmb mn	392	317	467	594	686	775
GP-GMO value to trait owners	Rmb mn	-	-	-	-	-	-
GP-GMO value to germ owners	Rmb mn	-	-	-	-	-	-
GP-Rice seeds	Rmb mn	443	383	340	421	459	508
GP-Vegetable seeds	Rmb mn	168	171	185	200	216	234
Gross margin-total	%	39%	34%	37%	37%	38%	39%
GPM-Corn seeds, fundamentals	%	40%	31%	35%	36%	36%	36%
GPM-Corn seeds incl. GMO & germ impv	%	40%	31%	35%	36%	36%	36%
GPM-Rice seeds	%	32%	29%	28%	30%	32%	34%
GPM-Vegetable seeds	%	57%	60%	60%	60%	60%	60%
GPM-Others	%	43%	37%	43%	43%	43%	44%
R&D investment	Rmb mn	346	275	298	344	373	402
As % of revenue	%	11%	8%	8%	8%	8%	8%
No of employees in R&D	#	456	451	n.a.	n.a.	n.a.	n.a.
as % of total	%	17%	17%	n.a.	n.a.	n.a.	n.a.
EBIT	Rmb mn	643	356	277	557	728	927
EBIT-recurring	Rmb mn	496	222	336	415	472	532
EBIT-share from Brazil	Rmb mn	85	47	2	2	2	2
EBITDA-recurring	Rmb mn	751	523	653	758	843	933
Net Profit	Rmb mn	116	62	(59)	142	256	395
Net Profit-recurring	Rmb mn	96	32	85	142	256	395
EPS	Rmb/sh	0.088	0.047	(0.045)	0.108	0.194	0.300
EPS-recurring	Rmb/sh	0.073	0.024	0.064	0.108	0.194	0.300
Operating cash flow	Rmb mn	1,365	1,369	219	287	579	765
Investing cash flow	Rmb mn	(536)	(570)	(467)	(539)	(583)	(629)
Free cash flow	Rmb mn	1,065	939	(247)	(251)	(4)	136
Net debt	Rmb mn	4,225	2,563	2,810	3,062	3,108	3,048
Net debt/Equity	%	67%	41%	44%	46%	44%	40%
FCF	Rmb/sh	0.81	0.71	(0.19)	(0.19)	(0.00)	0.10
BV	Rmb/sh	4.18	4.18	4.14	4.24	4.41	4.65
ROE	%	2.0%	1.1%	-1.1%	2.6%	4.5%	6.6%
ROE-recurring	%	1.6%	0.6%	1.5%	2.6%	4.5%	6.6%
ROIC	%	4.6%	2.3%	1.3%	3.6%	4.5%	5.2%

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 96: Key assumptions and financials - Longping (GMO case scenario)

Key assumptions and financials							
		2020A	2021A	2022E	2023E	2024E	2025E
Benchmark prices							
China corn price	Rmb/t	2,224	2,835	3,180	3,291	3,350	3,395
Corn seeds sales	kt	63.6	61.8	71.0	83.1	94.3	105.6
Mkt shr - Corn seeds	%	6%	7%	8%	9%	10%	11%
GMO penetration-corn	%	0%	0%	5%	23%	41%	59%
Rice seeds sales	kt	39.8	34.9	33.2	34.9	35.2	35.6
Mkt shr - rice seeds	%	7%	8%	7%	7%	7%	8%
Vegetables seeds sales	kt	0.2	0.2	0.2	0.2	0.2	0.2
ASP-Corn seeds, fundamental	Rmb/kg	15.5	16.4	18.7	19.9	20.2	20.4
ASP-Rice seeds	Rmb/kg	35.0	37.3	36.6	40.2	40.8	42.0
ASP-Vegetables seeds	Rmb/kg	1,575	1,533	1,582	1,628	1,678	1,728
Revenue-total	Rmb mn	3,291	3,503	3,801	4,412	4,826	5,286
Revenue-Corn seeds	Rmb mn	988	1,015	1,333	1,679	1,988	2,321
Revenue-Rice seeds	Rmb mn	1,390	1,304	1,214	1,402	1,435	1,494
Revenue-Vegetables seeds	Rmb mn	294	287	311	336	363	393
Revenue-Others	Rmb mn	618	898	944	995	1,039	1,078
Gross profit-total	Rmb mn	1,270	1,201	1,396	1,668	1,893	2,160
GP-Corn seeds, fundamentals	Rmb mn	392	317	467	594	686	775
GP-GMO value to trait owners	Rmb mn	-	-	1	12	33	64
GP-GMO value to germ owners	Rmb mn	-	-	2	16	49	105
GP-Rice seeds	Rmb mn	443	383	340	421	459	508
GP-Vegetable seeds	Rmb mn	168	171	185	200	216	234
Gross margin-total	%	39%	34%	37%	38%	39%	41%
GPM-Corn seeds, fundamentals	%	40%	31%	35%	36%	36%	36%
GPM-Corn seeds incl. GMO & germ impv	%	40%	31%	35%	37%	39%	41%
GPM-Rice seeds	%	32%	29%	28%	30%	32%	34%
GPM-Vegetable seeds	%	57%	60%	60%	60%	60%	60%
GPM-Others	%	43%	37%	43%	43%	43%	44%
R&D investment	Rmb mn	346	275	299	347	379	415
As % of revenue	%	11%	8%	8%	8%	8%	8%
No of employees in R&D	#	456	451	n.a.	n.a.	n.a.	n.a.
as % of total	%	17%	17%	n.a.	n.a.	n.a.	n.a.
EBIT	Rmb mn	643	356	279	579	792	1,062
EBIT-recurring	Rmb mn	496	222	336	417	478	545
EBIT-share from Brazil	Rmb mn	85	47	2	2	2	2
EBITDA-recurring	Rmb mn	751	523	653	760	850	949
Net Profit	Rmb mn	116	62	(57)	162	314	517
Net Profit-recurring	Rmb mn	96	32	87	162	314	517
EPS	Rmb/sh	0.088	0.047	(0.044)	0.123	0.238	0.393
EPS-recurring	Rmb/sh	0.073	0.024	0.066	0.123	0.238	0.393
Operating cash flow	Rmb mn	1,365	1,369	221	303	630	876
Investing cash flow	Rmb mn	(536)	(570)	(467)	(542)	(593)	(649)
Free cash flow	Rmb mn	1,065	939	(246)	(239)	37	226
Net debt	Rmb mn	4,225	2,563	2,809	3,048	3,060	2,927
Net debt/Equity	%	67%	41%	44%	46%	43%	38%
FCF	Rmb/sh	0.81	0.71	(0.19)	(0.18)	0.03	0.17
BV	Rmb/sh	4.18	4.18	4.14	4.26	4.46	4.78
ROE	%	2.0%	1.1%	-1.0%	2.9%	5.5%	8.5%
ROE-recurring	%	1.6%	0.6%	1.6%	2.9%	5.5%	8.5%
ROIC	%	4.6%	2.3%	1.4%	3.8%	4.9%	5.9%

Source: Company data, Goldman Sachs Global Investment Research

We adopt SOTP as our primary valuation methodology for Longping based on its traditional businesses, and potential new ventures into the GMO business. Our SOTP-based target price consists of:

- Rmb3.4/sh for the GMO traits business, based on 40x 2027E P/E to price in the 1st generation ramp-up of GMO commercialization, and
- Rmb9.1/sh for its conventional seed business, based on 30x 2025E P/E (average of local peers before 2019 when GM rerating started), discounted back to 2023E;
- We reference Monsanto's P/E range in 2005-2016, at 30-40x, as well as global peer Corteva's current trading range of 12-14x EV/EBITDA for GM seeds valuation, based on 2027E earnings after the full launch of 1st generation GM seeds.

Accordingly, we derive a new 12-month SOTP-based target price of Rmb12.5 /sh (17% downside), implying 116x 2023E P/E, 64x 2024E P/E, and 42x 2023E P/E.

Exhibit 97: SOTP Valuation - Longping

Valuations SOTP	EPS-25E Rmb/sh	EPS-27E Rmb/sh	Exit P/E x	Valuations Rmb/sh
Conventional seed	0.362	n.a.	30 x	9.1
GMO	0.031	0.123	40 x	3.4
Valuation	**0.393**	**0.688**		**12.5**

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 98: Forward P/E (x) - Longping

Source: Bloomberg, Company data, Goldman Sachs Global Investment Research

Exhibit 99: Share price trend chart - Longping

Source: Company data, Goldman Sachs Global Investment Research

Key risks

We see the following key upside risks to our investment thesis and target price for Longping. If these risks were to materialize, we may consider taking a more constructive stance on the stock.

1) Faster than-expected government approval of GM seed commercialization, which is the biggest swing factor for Longping's valuation. Also, the company may again step up its efforts on GM seeds through new acquisitions, yet we do not see any signs of a restart in the near term.

2) The hybrid rice pricing cycle may turn around faster-than-expected, led by increasing domestic demand and supply shortages. Corn pricing may also extend into 2023E,

leading to a more significant profit contribution.

3) Faster-than-expected recovery and turnaround of the Brazil business, which is still uncertain with ongoing transition and turnaround efforts.

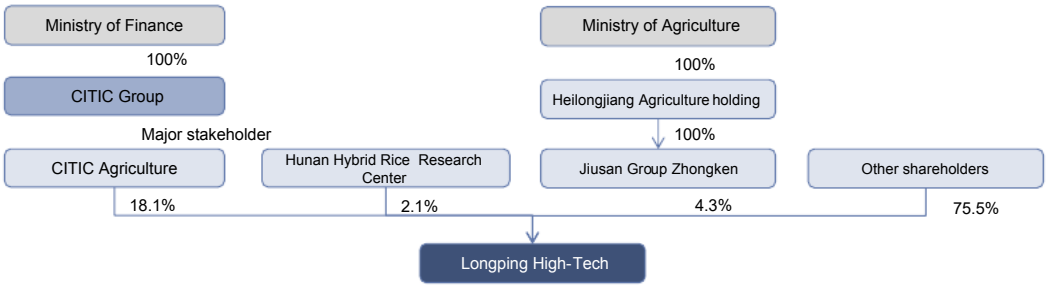
Company background - Longping

Longping High-Tech ("Longping") has been focused on the R&D of hybrid rice for more than 20 years. The company is the dominant player in China's hybrid seed industry, with c.7% market share in domestic rice seed and c.7% share in hybrid corn seed as of FY21. The company is also expanding into other seed categories like wheat, vegetables, etc., as well as agriculture service businesses.

Yuan Longping High-Tech Agriculture (Longping High-Tech) is a hybrid seed company named after renowned agronomist Yuan Longping, the "Father of Hybrid Rice". Longping High-Tech was founded in 1999 and listed on the Shenzhen Stock Exchange in 2000. Currently the major shareholder of the company is CITIC Group with an 18.1% stake. When the company was listed, its largest shareholder was Hunan Academy of Agricultural Sciences, which in 2004 sold its shares to Hunan Xindaxin Co., a privately owned company focused on real estate and agriculture.

In 2016, the companies issued shares to CITIC Construction and CITIC Industrial Group, two subsidiaries of CITIC Group, and CITIC Group became the major stakeholder of Longping High-Tech. In 2018, CITIC Construction and CITIC Industrial Group sold their shares in Longping High-Tech to CITIC Agriculture, another subsidiary of CITIC Group.

Exhibit 100: Shareholding structure as of 2021A - Longping



Source: Company data, Goldman Sachs Global Investment Research

MAO Changqing: Chairman. Previously worked as research analyst covering agriculture at Guosen Securities, now president of CITIC Agriculture and chairman of Longping High Tech

YUAN Dinggang: Vice Chairman. He worked at Zhuhai government previously. He received an EMBA degree from Wuhan University.

YANG Yuanzhu: Director, Chief expert in hybrid rice. He was a professor at different universities in China before joining the company.

LIN Xiang: CFO and director. He was also a director at CITIC Agri Fund. He received a MBA from Peking University. He is also a professional accountant and tax consultant.

M&A framework

Across our global coverage, we examine stocks using an M&A framework, considering both qualitative factors and quantitative factors (which may vary across sectors and

regions) to incorporate the potential that certain companies could be acquired. We then assign an M&A rank as a means of scoring companies under our rated coverage from 1 to 3, with 1 representing high (30%-50%) probability of the company becoming an acquisition target, 2 representing medium (15%-30%) probability and 3 representing low (0%-15%) probability. For companies ranked 1 or 2, in line with our standard departmental guidelines, we incorporate an M&A component into our target price. M&A rank of 3 is considered immaterial and therefore does not factor into our price target, and may or may not be discussed in research.

We consider the factors detailed below to evaluate the potential that certain companies could be acquired at a premium to current share prices.

1. Strategic asset: These include considerations of industry growth profile, gains in pricing power, cost saving synergies, blockbuster products, access to channels, etc. The introduction of 1st generation of GM seeds may trigger an acceleration in the consolidation of seed industry, and unlock higher growth potential. Hence, we assign a score of 2 to Dabeinong and Denghai.

2. Shareholding structure: The voting power of large shareholders and the management team matters to the probability of a company being acquired. Currently, Dabeinong and Denghai are both controlled by sole individual shareholders with no intention of transferring their controlling stakes to other parties. Accordingly, we assign a score of 3 to Dabeinong and Denghai.

3. Regulatory risks: Agriculture is generally a sensitive field for central government in China, especially given its impetus to address food security, seeking to become more resilient and self-sufficient in the face of uncertainty. Accordingly, we assign a score of 3 to Dabeinong and Denghai.

4. Company size: We consider the relative size of companies in its respective industry (top trait or germplasm owners in China), which make Dabeinong and Denghai potential acquirers more likely instead of acquirees. In the future, we see both companies would target to acquire small players in the industry with aim to leverage its operational advantages and consolidate the market. Hence, we assign a score of 3.

We have assigned different weights to each of these factors to show their relative importance to driving M&A: Industry consolidation: 30% to strategic asset and shareholding structure, and 20% to regulation risks and size. By applying this framework, Dabeinong and Denghai both rank 3, and accordingly we factor no M&A value into our 12-month target price.

Exhibit 101: M&A framework for Dabeinong & Denghai

Ticker	Company name	Rating	1) Strategic assets	2) Shareholding structure	3) Regulation risks	4) Size	Final M&A Rank (1=high prob: 3=low prob)
		Weight	30%	30%	20%	20%	
002385.SZ	Dabeinong	Buy	2	3	3	3	3
002041.SZ	Denghai	Neutral	2	3	3	3	3

Source: Goldman Sachs Global Investment Research

All prices in this report are as of Aug 5 2022 close, unless otherwise stated.

Disclosure Appendix

Reg AC

We, Trina Chen, Roy Shi, Christina Qin and Arthur Deng, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

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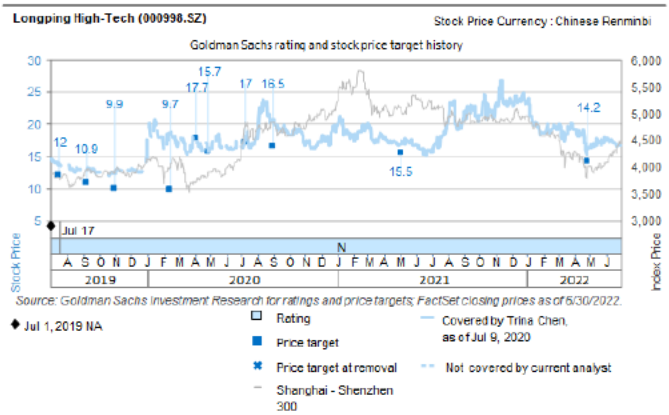

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