The Outlook for China's Soybean Imports

Slowing Protein Production Yields to Policy Objectives

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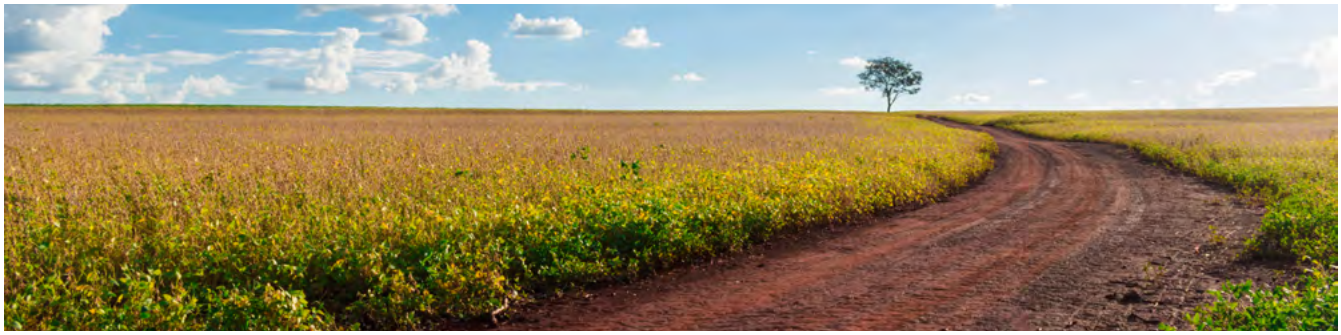
S&P Global
Commodity Insights



Executive summary

China is the largest importer of soybeans in the world, and the commodity is used as a central ingredient in livestock and aquaculture feed. Recent trends indicate that growth in China's soybean imports is exceeding that of animal feed production and government policy is steadily becoming a more central driver. This, combined with an expected slowdown in China's protein production is leaving soybean import demand increasingly uncertain.

This paper aims to shed light on the uncertain future for China's soybean imports by analyzing selected domestic policies. Three potential future paths are explored, underpinned by individual strategic government policies:

- **Domestic Expansion Scenario** assumes China's domestic production of soybeans expands in line with recent policy announcements, but that targets for the use of soybean meal in feed are relaxed.
- **High Stocks Scenario** assumes that China accumulates increasingly large stocks of soybean stocks, reaching levels comparable to those estimated in China for rice, corn, and wheat.
- **The Combined Case** assumes that soybean stocks are accumulated and that domestic soybean production increases. The use of soybean meal in feed is also assumed to rise relative to current levels.

The results of the scenario analysis show that under all scenarios, with assumed slowing protein production, the outlook for China's soybean imports is relatively bearish. In the High Stocks Scenario, China's soybean imports in 2029 are projected to be just 0.6% higher than in 2023 at 118.8 million metric tons (MMT). This is a fraction of the growth observed over the last decade (4.5% p.a.) with virtually all the increase driven by an assumed stock accumulation policy. This increase is relatively rosy however when compared to the Domestic Expansion Scenario which projects a 3.2% reduction in China's soybean imports between 2023 and 2029 (to 107.9 million metric tons). Here, rising local supplies increase competition for imported soybeans effectively displacing them from the market.

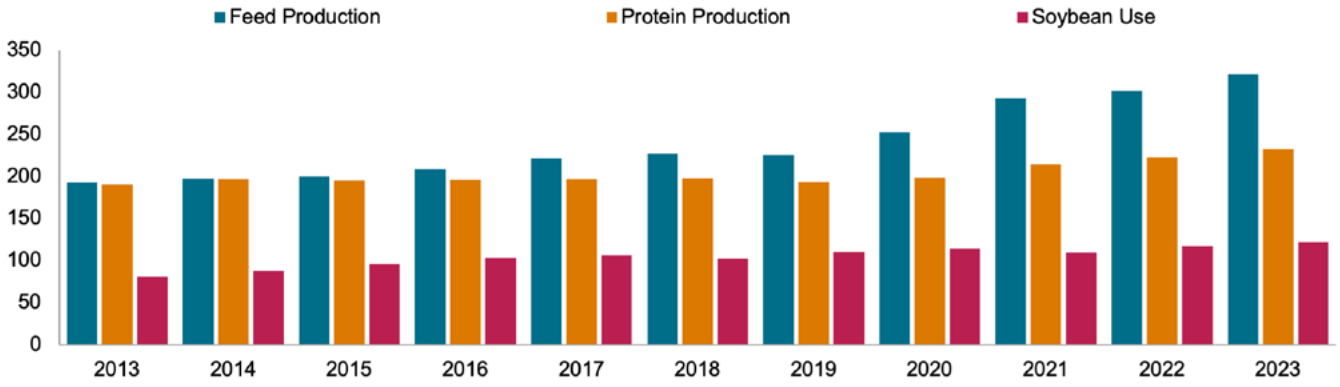
In the Combined Case, expanding stocks drives an increase in China's soybean imports to 118.2 MMT in 2029. This is, however, comparable to that in the High Stocks Scenario, with additional impacts to import demand counterbalanced by rising Chinese production and assumed relaxation of soybean use policies. A result that highlights the complex interaction between China's agrifood policies and the potential for policy-driven production growth to be overshadowed by other policy mechanisms.

Irrespective of whether China can achieve its soybean production growth plans, the scenario analysis presented here suggests soybean markets can expect downward pressure on real prices in the short to medium term. Not only is protein production — the fundamental driver of soybean demand in China — expected to slow but most of the growth may hinge on the pursuit of elevated stocks, a policy mechanism that is typically employed to Downward pressure over this period could also result from a further expansion in domestic soybean production which would increase competition for imported supplies. Lastly, if stock volumes do continue to accumulate in China, any additional imports will likely feed into a policy mechanism (i.e. accumulated strategic reserves) that is designed to suppress the price levels and reduce volatility.

China's feed industry is a globally significant importer of soybeans

In 2023,[1] China imported 111.5 million metric tons of soybeans, accounting for around two-thirds of global trade. Approximately 80% of China's soybean imports are reportedly for use in feed production,[2] underscoring soybean's role as a cost-effective source of crude protein. Soybeans and soybean meal have emerged as the preferred protein source for animal feed in China, primarily due to their competitive pricing compared to other protein meals like rapeseed and sunflower meals. Historically, soybean prices have been significantly lower than those of other oilseeds, making them a more cost-effective choice for feed producers. For example, in 2023, the average import price of soybeans in China was around $500 per ton, whereas rapeseed and sunflower seeds both surpassed $900 per ton. This pricing advantage is further enhanced by the high protein content and excellent amino acid profile of soybean meal, which lessens the reliance on costly synthetic amino acid supplements.

Figure 1: China's Feed Production and Soybean Use Outpace Protein Production (MMT)



As of Nov. 15, 2024.
Source: S&P Global Commodity Insights, USDA, Chinese Ministry of Agriculture and Rural Affairs.

China's imports of soybeans are also significant given its limited domestic production capacity and high demand. In 2023, China produced just 20.0 million tons of soybeans,[3] with imports accounting for around 85% of its soybean supply. The rising production of fish, meat, dairy and eggs (hereafter referred to as 'protein') in China has therefore led to a substantial increase in China's feed production, soybean use and ultimately imports. From 2013 to 2023, China's protein production grew by 22.1% (42.2 million tons), while feed production and soybean use increased by 66.8% and 49.4% respectively.

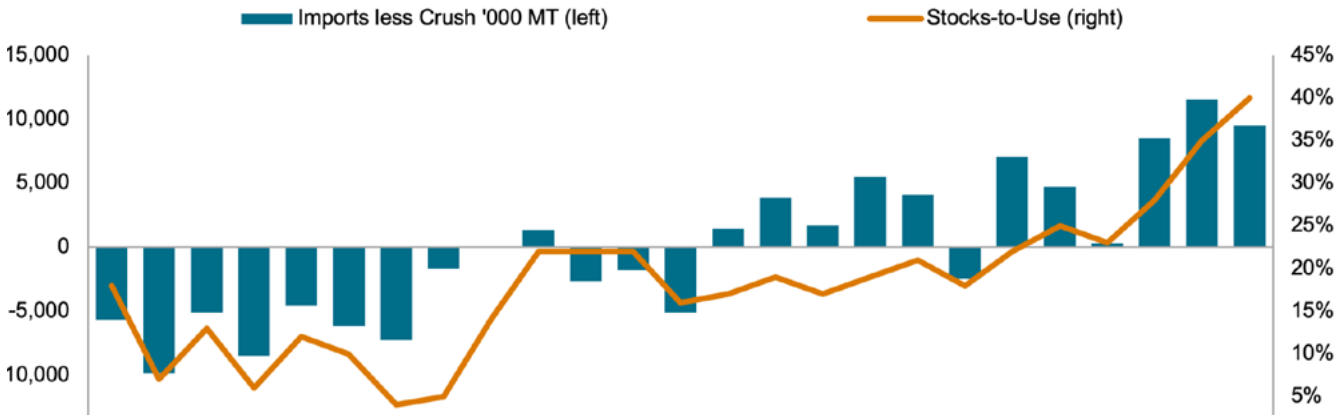
1) This refers to the 2023-2024 marketing year. Subsequent references in this paper will use this format for marketing years.
2) Commodities 2023: China's soybean imports to recover on improved margins, restocking needs, http:/www.spglobal.com/commodityinsights/en/market-insights/latest-news/agriculture/122322-chinas-soybean-imports-to-recover-in-2023-on-improved-margins-restocking-needs
3) The relatively low production of soybeans in China has been widely studied with limited output in large part explained by low yields relative to other major producers like Brazil and the United States and low prices (particularly relative to corn) for China's crop farmers.

Expanding soybean stocks mask softening demand from feed-use industries

Slower growth in protein production is expected in China over the short to medium term due to projected declining growth in incomes and urbanization (See for example S&P Global's 2023 analysis "China's Aging Demographics"). Over the past thirty years, China's real gross domestic product (RGDP) has increased at an average annual rate of 8.2%. However, this growth rate has been consistently declining, with RGDP rising by only 5.9% per year over the last decade. According to S&P Long-term forecasts and the World Bank, this growth rate is projected to further decrease to 4.5% per year through 2029. While this rate remains robust by the standards of developed countries, it represents a significant reduction compared to the growth experienced over the previous three decades. By 2029, the output of China's protein industries is projected to increase by just 1.5 million tons to 209.95 million tons. This represents an average annual growth of just 0.12% and is far slower than the 1.8% growth rate observed over the decade up to 2023.

The expected slower growth in protein production will likely create challenging headwinds for feed and soybean meal use in the future. However, this historically strong relationship has decoupled since 2013 with imports exceeding the volume of soybeans crushed for feed in all but one year (2019). In 2023 imports exceeded the volume crushed by more than 11.5 million tons with most of the residual assumed to be entering stocks.[4]

Figure 2: China Soybean Imports Outpace Crush[5]



As of Nov. 27, 2024.
Source: S&P Global Commodity Insights.

4) In addition to being added to stocks, the residual soybeans could be utilized in a variety of food products, including tofu, soy sauce, and tempeh. They can also be applied in industrial uses, such as biodiesel production and the manufacturing of items like crayons and inks.

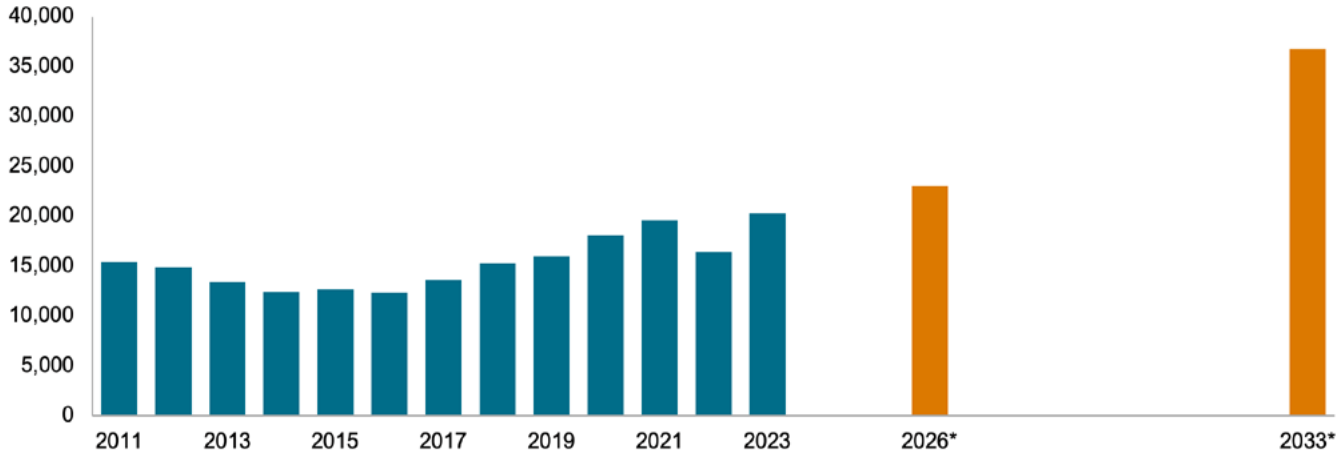
5) The graph illustrates the USDA's estimate for the 2023 marketing year along with its forecast for the 2024 marketing year.

At the end of 2023, China's soybean ending stocks are estimated to total 42.9 million metric tons, nearly triple the level from a decade ago. In 2006, China's soybean ending stocks versus total demand, known as a 'stocks-to-use ratio', stood at just 4%. This ratio is a common measure of supply and demand in a commodity market with high (low) values indicating a stronger (weaker) supply relative to demand. As of 2023, China's stocks-to-use ratio has surged to approximately 35%. China's soybean stocks-to-use ratio is notably high compared to other major soybean importers—such as the European Union, Southeast Asia, and Mexico—are 7.94%, 7.51%, and 3.98%, respectively, according to the USDA. For China, the relatively high level of soybean stocks is not unusual. In 2023, the stocks-to-use ratio of rice and corn was around 70%, and for wheat, China is estimated to hold stocks equal to around 90% of annual use.

Rising Domestic Production May Also Create Headwinds for Imports and Lift Uncertainty

Alongside the expansion of stocks, China has made a range of announcements that point to growing domestic soybean production. China's 2024-2033 Agricultural Outlook Report for example targets a 75% increase in soybean production over the next decade. This growth is planned to be driven by expanded soybean planting areas and productivity gains from genetically improved yields.[6] This includes the use of genetically modified (GM) technologies, with China's Ministry of Agriculture and Rural Affairs authorizing 37 GM corn varieties and 14 soybean varieties in December 2023.[7]

Figure 3: China Domestic Soybean Production ('000 MT)



As of Oct. 31, 2024.
Source: S&P Global Commodity Insights, Chinese Ministry of Agriculture and Rural Affairs.

This potential increase in domestic soybean production, coupled with expected slowing demand from the feed industry is resulting in an increasingly uncertain environment for China's soybean market. To better understand the potential future path of China's soybean import demand, a scenario analysis is undertaken within a supply disappearance model. The remainder of this paper outlines the methodology of the scenario analysis, the results and the implications of the findings.

6) China Agricultural Outlook Report 2024-2033, https://www.dcz-china.org/wp-content/uploads/2024/10/2024-10-12_Study_China-Agricultural-Outlook-2024-2033.pdf

7) The approval followed a three-year trial period and represents a first for staple food crops, (GM has previously been limited to cotton and papaya crops). Announcement No. 732 of the Ministry of Agriculture and Rural Affairs of the People's Republic of China

Scenario Analysis

Scenario analysis is a valuable tool in economic modeling as it allows analysts to explore the potential impacts of different variables and assumptions on economic outcomes. This scenario analysis is undertaken within a standard supply disappearance model and uses data from an array of sources including USDA, S&P long-term forecasts, and China's Ministry of Agriculture and Rural Affairs (MARA).

Three key scenarios are assessed that aim to understand how soybean demand might be influenced by selected market and policy outcomes with a number of sensitivities performed to test the robustness of the modeling results. The scenarios are summarized on the right:

1. **Domestic expansion** — assumes domestic soybean production in China meets government growth targets
2. High stocks — assumes China holds similar levels of soybean stocks as other grains by 2029
3. Combined case — assumes both higher stocks and an expansion in domestic soybean production

For all scenarios, S&P Global projects protein production (i.e. output from China's aquaculture and livestock sectors) to reach around 210 million tons by 2029, with feed production totaling approximately 315 million tons in that year.[8] A summary of selected modeling parameters and assumptions is provided in Table 1 with each scenario described in further detail in the following sub-sections.

Table 1: Selected assumptions at 2029 for analysed scenarios

	Units	Domestic expansion	High stocks	Combined case
Fish and livestock production	MMT	209.9		
Domestic feed production	MMT	315.9		
Soybean meal share of compound feed	%	14.5%	12.5%	14.5%
Domestic soybean production	MMT	28.1	20.1	28.1
Soybean stocks to use ratio	%	30.0%	70.0%	70.0%
Assumed total soybean use	MMT	136.0	129.6	136.0
Implied soybean stocks	MMT	40.8	90.7	95.2

Scenario 1: Expanded domestic production

In this scenario, domestic production of soybeans increases in line with the targets stated by the Chinese Government. Assuming the path to the announced 2033 target is linear, the implied volume of production in 2029 is around 28.1 million metric tons. This would be an increase of around 40% on that produced in 2023 (around 20 million tons), and with an average annual growth rate of 5.1% a year would be a touch lower than the 5.3% averaged over the 10 years to 2023.

This scenario assumes that relative stocks of soybeans remain at current levels around 30% of use and that soybean's input share of feed production remains at around current levels. This scenario assumes that the Three-Year Action Plan announced in 2023 to reduce soybean's footprint in compound feed is not met amidst the policy drive to increase production (see Appendix A: scenario analysis for more detail).

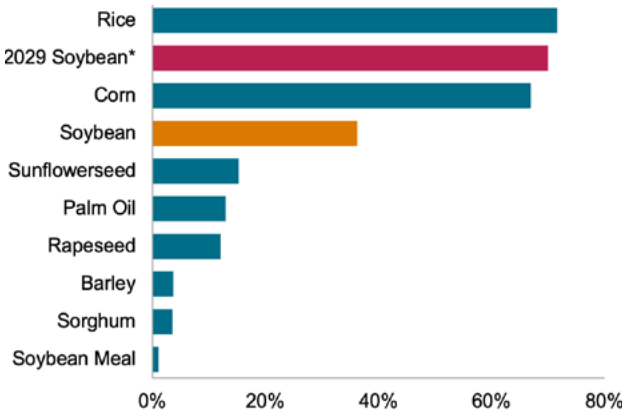
8) S&P Global long term forecast, available at: https://connect.ihsmarkit.com/document/show/phoenix/5792250?connectPath=FoodCommoditiesOutlooksLandingPage.GlobalLivestock

Scenario 2: High stocks

This scenario describes a short to medium term world where China continues to accumulate stocks of soybeans. In this scenario, it is assumed that by 2029 the volume of soybean stocks held relative to its use is comparable to those currently held of other major commodities in China. This includes rice and corn where stocks-to-use ratios are currently around 70% and is more than double the current ratio assumed held in 2023 (around 30%).

With an assumed total soybean use of around 129.6 million metric tons in 2029, a stocks-to-use ratio of 70% implies soybean stocks in that year of around 90.7 million metric tons. For China this would mean accumulating around 48.7 million metric tons of additional soybeans in stocks by 2029 to lift that held from the current estimated volume of 42 million tons. It is assumed that in this scenario, China's domestic production of soybeans remains unchanged from current levels the volume averaged over the last two decades (around 20 million metric tons). This scenario consequently implies heavy import reliance remains and as such it is assumed that the Chinese government continues to pursue policy measures

Figure 4: China 2024 Stocks-to-Use Ratios



As of Nov. 14, 2024.
Source: S&P Global Commodity Insights, USDA.

that reduce the footprint of soybeans as an ingredient in compound feed. By 2029 it is assumed that the proportion of compound feed that is comprised of soybeans is around 10%, 2.5 percentage points below that currently averaged (see Appendix A).

Scenario 3: Combined case

In this scenario, it is assumed that China's domestic soybean industry expands as in Scenario 1, and that soybean stocks continue to accumulate as in Scenario 2. All combined, this scenario assumes a 40% increase in Chinese soybean production by 2029 and an 85% increase in the volume of soybean stocks held. With domestic production assumed to expand in this scenario, it is also assumed that soybean use in feed remains at current levels (around 13.0%) with the 2023 Three-Year Action Plan not met amidst the policy drive to increase production (see Appendix A).

It is important to note that none of the three scenarios presented include a situation where soybean meal usage in feed falls below 12.5%. Livestock species, such as broilers, pigs, dairy cows, and aquaculture species like tilapia and shrimp, have specific protein requirements that are vital for their growth and productivity. Broilers generally require about 20-24% protein in their diets, while pigs need approximately 16-20%. Dairy cows require around 16-18% protein to maintain milk production, and aquaculture species often have comparable protein needs, with tilapia and shrimp requiring about 25-30% protein for optimal growth rates. Considering these critical protein requirements, it seems unlikely that the Chinese government will be able to reduce soybean meal inclusion in feed below 12.5% in the short to medium term, as doing so could compromise the nutritional adequacy of feed formulations and ultimately affect livestock performance.

Result

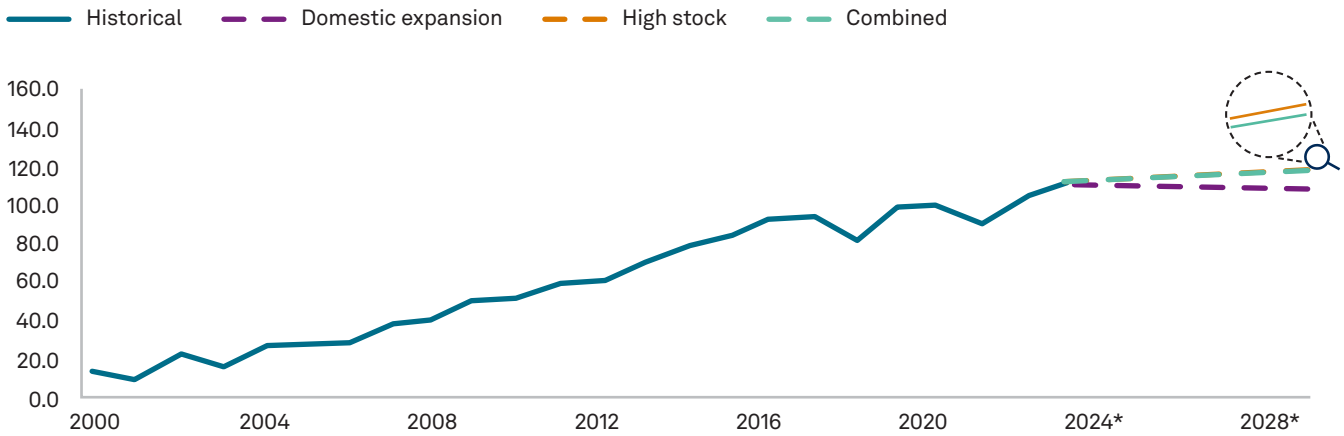
Summary results of the scenario analysis are provided in Table 2 below.[9]

Table 2: Summary results at 2029

	Units	Domestic expansion	High stocks	Combined case
Projected Imports	MMT	107.9	118.8	118.2
Change From 2023	%	-3.2	6.5	6.0
Change From 2023	MMT	-3.6	7.3	6.7

The Domestic Production scenario presents a relatively bearish outlook over the short to medium term. By 2029 increased domestic soybean production in China is projected to reduce imports to 107.9 million tons, 3.2% lower than that imported in 2023 and comparable to the volume shipped in 2022. In this scenario, assumed limited growth in feed production or held stocks means the increase in China's domestic soybean production increases competition with and substantially reduces demand for imported supplies, even with a slight increase in the soybean meal share of compound feed. In the High Stocks scenario, soybean imports are projected to total 118.8 million metric tons in 2029 with most of the increase in imports between 2023 and 2029 assumed to enter stocks. While this would represent a 6.5% increase in imports over that recorded in 2023, at just 0.6% per year on average, the projected growth under this scenario is very modest compared to that observed in the last decade (4.0% on average).

Figure 5: Historical and projected soybean imports, China (million metric tons)



As of Nov. 27, 2024.
Source: S&P Global Commodity Insights.

9) All scenarios indicate a notable decline in imports in 2024 compared to 2023, attributed to a 7 million metric ton increase in imports from 2022 to 2023, during which 10 million metric tons of soybeans were added to stocks. This led to a decrease in non-stock uses of soybeans in 2023, and if stocks remain unchanged, imports would have seen a reduction of 3 million metric tons that year. In the domestic expansion scenario, where a slight decline in stocks is assumed, the year-over-year decrease in imports is projected to be around 13 million metric tons before stabilizing towards the long-term trend.

In the Combined case, which includes increases in domestic production and a rising stocks-to-use ratio, China's soybean imports are projected to total 118.2 million metric tons. While this figure would result in a 6% increase in imports compared to 2023, the annual growth rate would be well below what was observed over the last decade. This scenario illustrates how rising stocks and a return to earlier soybean meal proportions in compound feed would overshadow the effective execution of China's domestic production policy objectives, thereby boosting import demand in the short term.

Notably, the High Stocks scenario and the Combined case are nearly identical in the short term, with the primary differences stemming from their underlying assumptions. The High Stocks scenario assumes stable domestic production and soybean meal proportions in compound feed, while the Combined case anticipates higher domestic production and increased soybean meal proportions. By 2029, the two-percentage-point difference in soybean meal leads to 7.4 MMT more soybean use in the Combined case compared to the High Stocks scenario. Additionally, domestic soybean production in the Combined case is projected to be 8 MMT higher, driven by Chinese government targets that significantly exceed the S&P long-term forecast. Consequently, this results in a 0.6 MMT difference in import volumes between the two scenarios for 2029.

Essentially, these two scenarios demonstrate that the adverse impact on imports from increased domestic production can be mitigated in the short term by simply returning to the soybean meal proportions in compound feed levels seen in 2022. In the long term, if the soybean meal proportions for the Combined case and the High Stocks scenario remain at 14.5% and 12.5%, respectively, and the gap in domestic production between the two scenarios continues to widen, the import levels for the Combined case would drop below those of the High Stocks scenario.

Conclusion

The scenario analysis presented here suggests a relatively bearish outlook for Chinese soybean import demand in the short to medium term. While two of the three scenario analyses saw increases in imports, projected growth is at best modest compared to that observed over the last decade.

One of the three scenarios analyzed showed that expanded domestic production of soybeans in China could result in lower imports than would otherwise be expected. However projected local production growth is relatively modest compared to total soybean use in China. Because of this, the effect of increased production on import demand might be concealed by other significant policy decisions, including targets for soybean use in feed — which were introduced to reduce import reliance — and the accumulation of strategic reserves or stocks. Of the analyzed scenarios that do project positive growth, effectively all the increase is contingent on China accumulating additional soybean stocks in the short to medium term. China's stocks of strategically important agricultural products are unknown and are influenced by a wide array of complex policies – from outright level targets to indirect influences like price supports.

The degree to which soybean stocks may rise (or fall) in the future is uncertain. However elevated stocks are thought to be common in China with very high stocks (relative to use) for other strategically important commodities like rice, corn, and wheat. A range of international organizations estimate that stocks of these commodities have remained relatively constant over the last 5-years, with the only material drawdown occurring in 2016 when China actively sold some of its corn reserves while also reducing price supports. Even then, it is estimated that this saw only a 5% reduction in corn stocks. Regardless of whether China does pursue expanded soybean stocks, it is likely that soybean markets can expect downward pressure on real prices in the short to medium term. The fundamental driver of soybean demand in China is feed use and short to medium-term growth in protein production is expected to slow. Downward pressure over this period could also result from a further expansion in domestic soybean production which would increase competition for imported supplies. Lastly, if stock volumes do continue to accumulate in China, any additional imports will likely feed into a policy mechanism (i.e. accumulated strategic reserves) that is designed to suppress the price levels and reduce volatility.

Appendix A: Sensitivity Tests

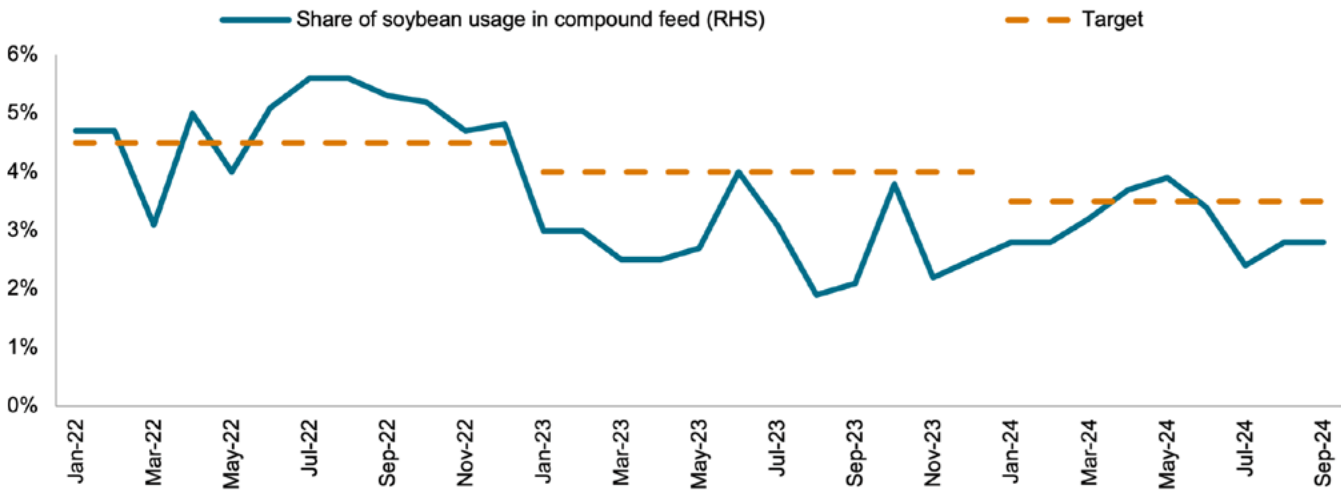
The scenario analysis presented above focuses on selected variables of interest to China's soybean imports, namely the potential for growth in domestic production and accumulation of stocks. This appendix outlines a range of tests to assess how sensitive the modelling results are to changes in selected other variables. Two variables were chosen for sensitivity tests:

1. The share of feed comprised of soybean meal
2. Feed intensity — the degree to which China's livestock commodities use feed as an input (the analog of feed conversion)

A1. The share of feed comprised of soybean meal

In recent years, China has announced and implemented an array of policies targeting reduced reliance on imported soybeans.[10] This includes for example the 14th Five-Year Plan for National Forage Industry Development and the Three-Year Action Plan aimed at reducing soybean meal usage in feed. The plans specifically target an annual 0.5 percentage point reduction in the share of soybeans used in compound feed starting at 14.5% in 2022 and aiming to reach 12.5% by 2025.

Figure 6: Share of Soybean Use in Compound Feed (%)



As of Nov. 18, 2024.
Source: S&P Global Commodity Insights, China Feed Mill Association

10) Increasing import prices and dependence on imports from concentrated suppliers, including the United States, have prompted the government to encourage feed farming companies to adopt low-protein diets.

Following the announcement of this soybean use target, the proportion of feed composed of soybean meal has been lower. In 2023 the targeted share was 14.0% and soybean use averaged 13.0% for the year, exceeding the target by a full percentage point. For 2024, the target was reduced to 13.5% with year-to-date (as of September) soybean meal use equating to around 12.5% of the feed makeup.

If the current share of soybeans in feed is maintained for the remainder of the year, China will have met its goal within its targeted time frame (12.5% by 2025). Beyond this though, there is currently no guidance on the planned inclusion rate for soybeans in feed. Reflecting this uncertain future path, the scenario analysis presented in the main body of this report looks at two potential outcomes:

1. The 12.5% target is maintained over the remainder of the modeling horizon (12.5%), or
2. That soybean use rates return to levels observed when the plan was first announced (14.5% in both the Expanded Production and Combined scenarios).

The latter of these values was selected as it was reasoned that in cases where domestic production was to expand (as in the Expanded Production and Combined scenarios), other policies that restrict sales of soybeans may likely be relaxed (as a target for soybean meal share of feed ingredients).

This sensitivity analysis tests a wider range of soybean meal shares of feed to assess how material changes in this variable are to the core results presented in the main body of the paper. Here two soybean meal inclusion rates are tested: a higher 16.5% rate and a lower rate of 10%.

Table A1: Soybean meal use share sensitivity test

		Units	Domestic expansion	High stocks	Combined case
Central	**Soybean meal share assumption**	%	14.5%	12.5%	14.5%
	Projected imports	MMT	107.9	118.8	118.2
Low sensitivity	**Soybean meal share assumption**	%	10.0%	12.5%	14.5%
	Estimated import volume	MMT	92.9	105.3	101.3
	Change in 2029 imports from central scenario	%	-13.9%	-11.3%	-14.3%
	Change in imports from 2023	%	-16.7%	-5.5%	-9.1%
High sensitivity	**Soybean meal share assumption**	%	16.5%	90.7	95.2
	Estimated import volume	MMT	114.5	133.8	125.7
	Change in 2029 imports from central scenario	%	6.1%	12.6%	6.3%
	Change in imports from 2023	%	2.7%	20.0%	12.8%

This sensitivity analysis highlights that policy changes that affect the rate at which soybeans are used in feed can have a material impact on China's future soybean imports. However, most material impacts only occur in cases assessed as having a low likelihood of occurring, requiring sets of contradictory government policies. The largest modeled change was observed when domestic production is elevated but soybean use is low (-13.9 % change in project import volume in 2029) — meaning the government would support production but restrict end use — or when stocks accumulate but soybean use is high (+12.6%) – meaning the government would simultaneously support stockpiling and expanded end-use.

In the other tested cases, changes to the rate of soybean use in feed did not have a linear effect on future import volumes. In particular, changes to soybean inclusion rates were assessed as having a more material impact on import volumes when stocks are accumulated versus a scenario where China's domestic soybean industry expands. In the Domestic Expansion scenario, a 4.0 percentage point increase in the proportion of feed comprised of soybeans results in just a 6.1% increase in imports. In contrast, reducing soybean use by 2.0 percentage points in the High Stocks scenario leads to an 11.3% reduction in imports.

Although the soybean meal share variable is significant and does influence soybean imports, its overall effect is relatively small. For example, in the Domestic Expansion scenario, a 2% rise in the soybean meal share in feed (from 14.5 to 16.5) leads to only a 6% increase in imports. When examining shifts of just 0.5%, as observed between 2023 and 2024, the implications become even less pronounced. Such a slight change in soybean meal share results in only a minimal adjustment in import volumes, suggesting that while the variable is important, its actual

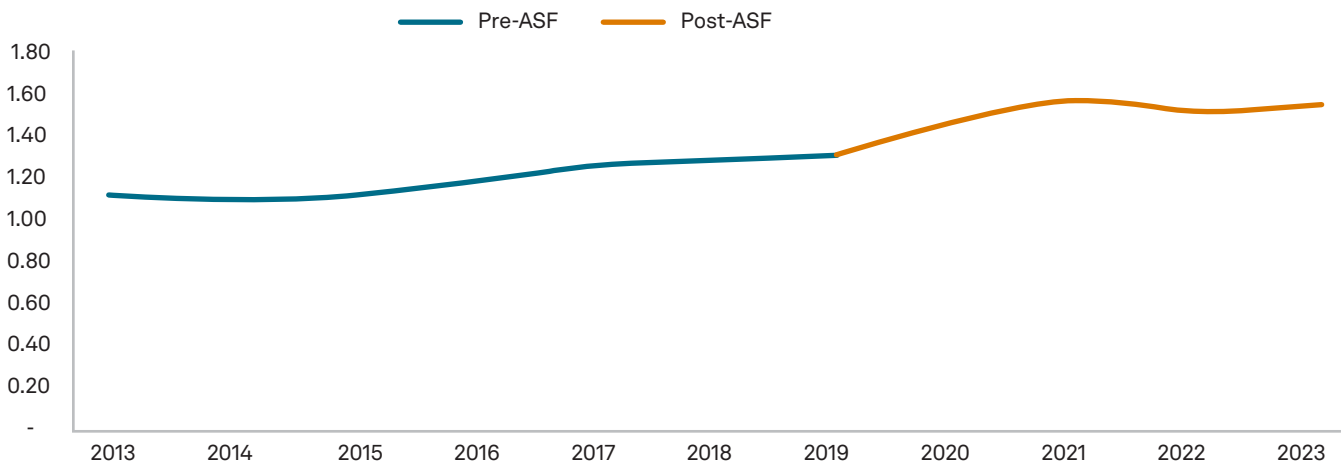
A2. Feed Intensity

A core assumption in the modeling outlined in the core body of this report is that feed use intensity remains constant (i.e. the ratio of feed production grows at an equivalent rate to the output of the proteins sector). Between 2013 and 2019 feed use intensity in China declined with feed production growing faster than the rate of increase for the livestock and aquaculture industries.

In 2013 the ratio of feed production to protein output was around 1.11. By 2018 this had risen to 1.26, implying an extra 0.15 tons of feed was required to yield a ton of protein. The main drivers of this were China's pig and broiler industries where meat production collectively fell by 5.7% in the 5 years to 2018, while feed production for use in these industries rose by 21.5%. This trend in feed use in China during this period contrasts with other major meat producers where growth in animal production has largely outpaced feed production. According to US Department of Agriculture data, growth in meat production[11] outpaced the use of grain as feed, reducing feed intensity by around 8.1% in the decade to 2023-24. In Europe, over the same period, feed intensity fell by 11.1% over the same period.

11) Excludes Aquaculture

Figure 4: Protein industry feed use intensity, China (ratio of protein to feed production)



As of Oct. 31, 2024.
Source: S&P Global Commodity Insights, National Bureau of Statistics China.

The arrival of African Swine Fever (ASF) in China in mid to late 2018, has significant disrupted the meat and feed industries. Initially, the weakening of feed intensity was accelerated, with the ratio of feed and protein production rising to 1.57 in 2021. Since then, though, the intensity of feed use in China has averaged marginally lower at around 1.63.

The scenario analysis in the main body of this report assumes feed use intensity is steady out to 2029, taking the rate averaged over the last 5-years. As a result, the modeling assumes changes in protein production linearly translate to feed production. This sensitivity analysis tests how material changes to feed use intensity affect the modeling results. Two specific sensitivities are performed:

1. Rising feed intensity: Feed intensity begins to rise again at a rate comparable to that observed prior to the arrival of ASF (0.2 points p.a.) reaching 1.89 in 2029, and
2. Weaker feed intensity: Feed intensity experiences a comparable to the United States and Europe, falling by 9.5% to reach 1.4 in 2029.

The results of the sensitivity test are described in Table A2 below. In the Rising Feed Intensity sensitivity, a 22.5% increase in the feed intensity ratio (to 1.89) results in soybean imports being 9.5 to 9.8% higher in 2029 compared to the central modeling scenario. While the magnitude of this effect is relatively moderate, the test highlights that future structural changes in China's livestock sector will be a central aspect of future feed and soybean import demand.

Most of the historical growth in China's feed use intensity is assessed as resulting from structural changes to production systems within the pig and broiler industries. This includes reduced reliance on breeding animals, with rising piglets per sow for example leading to growing feed demand. The trend of reduced feed use intensity also likely reflects a move from free-range type systems to indoor production methods where feed is a major input.

Should these structural changes continue feed production and soybean import demand may find additional support than would otherwise be expected. Of particular note are recent announcements by the Chinese government to lift productivity in its cattle sector. While details remain limited, structural changes for an industry that is characterized by outdoor grazing and smallholder production systems could see growth in feed demand continue to exceed meat production growth.

Table A2: Feed Use Intensity sensitivity test

		Units	Domestic expansion	High stocks	Combined case
Central	**Feed Use Intensity assumption**	1.54			
	Projected imports	MMT	107.9	118.8	118.2
Rising feed intensity	**Feed Use Intensity assumption**	1.89			
	Estimated import volume	MMT	118.2	130.5	132
	Change in 2029 imports from central scenario	%	9.5%	9.8%	11.7%
	Change in imports from 2023	%	6.0%	17.0%	18.4%
Falling feed intensity	**Feed Use Intensity assumption**	1.40			
	Estimated import volume	MMT	104.5	115.5	114.4
	Change in 2029 imports from central scenario	%	-3.2%	-2.8%	-3.2%
	Change in imports from 2023	%	-6.3%	3.6%	2.6%

The Falling Feed Intensity sensitivity indicates that soybean import demand could be lower if productivity improvements in China lead to feed conversion gains that drive output growth similar to what has been observed in the European Union or the United States, although the impact is expected to be relatively minor. Were China's feed intensity to decrease by 9.5% out to 2029, soybean imports could be between 2.8 and 3.2% lower than that modelled in the central scenario. These effects may be compounded by a future shift in Chinese diets and meat production to less feed intensive proteins like aquaculture. In 2023, China's pig and aquaculture industries both produced approximately 58.0 million metric tons. The pig industry needed nearly 150 million metric tons of feed that year, whereas feed production for the aquaculture sector was significantly lower at only 24 million tons. Despite a trend in China's aquaculture production towards crustaceans and shellfish, which typically require slightly more feed than carp and other fish species, this shift is not expected to significantly affect the intensity of feed use in aquaculture. Continued strong growth in aquaculture demand (particularly at the expense of other proteins) could see feed use intensity materially decline in the short term.

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