

# China Wheat-Flour Supply-Chain

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## Recent Trends and Export Prospects

### Prairie Grain Portal

Wheat Consumption Trends

Wheat Production Trends

Flour Milling Industry

Wheat Import Outlook



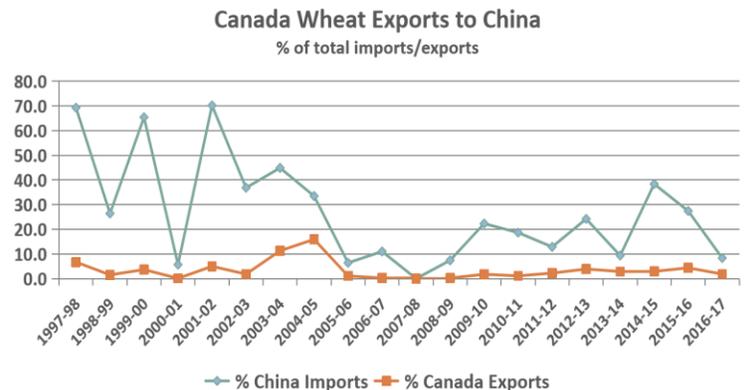
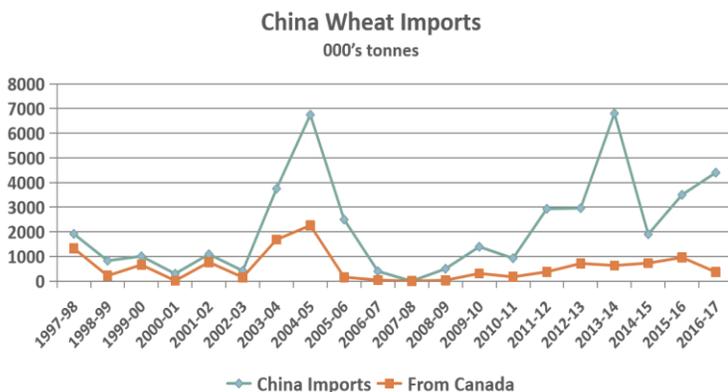
## Introduction

China became the world's largest grain importer and increased its imports from Canada to become our largest grain export destination, with a 20% share. China's grain imports increased to 130 MT/year, but mostly driven by feed rather than food needs, with soybean becoming the principal import-crop at close to 75% of the total. Wheat has been a minor share in China's import-mix; having peaked at 7 MT in the early 2000s and again in the early 2010s, lately it has been in the 4-5 MT/year range, little more than canola but less than sorghum or barley.

China is the world's 2<sup>nd</sup> largest wheat producer, also at about 130 MT/year, only 12% less than the largest, EU. Wheat and rice have been the country's two food staples, consumed in equal quantities. Self-sufficiency has been the goal in both, though achieved in rice, not always in wheat, requiring an average of 10 MT of imports a year through the 1980s and 1990s. Lately China has been producing as much wheat as it consumes, but it continues to import to build up its stocks – largest wheat-reserves in the world, equivalent to one year of its consumption.

We on the other hand are a much smaller wheat-producer, 7<sup>th</sup> in the world with 30-35 MT/year but export two-thirds of what we produce, making us 5<sup>th</sup> largest exporter. But more important than our export volume is the quality of our grades or varieties, particularly durum. Going back 20 years, China used to source 60-70% of its wheat imports from us, lately that share has been below 10% – 2-3% of our wheat-exports of late, down from its peak at 16% in the mid-2000s.

Lately our trading relations with China have soured, threatening our grain exports altogether. We are not sure whether we can restore these relations to continue exporting grains to China, but we thought we would revisit some of the opportunities we had identified a few years ago, particularly with respect to containerized wheat exports to the milling industry, which has gone through a technological revival, and needs high grades of wheat to improve flour quality.



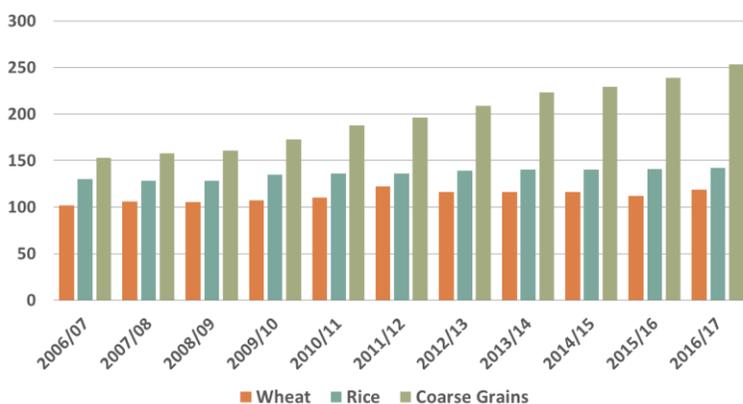
## Wheat Consumption Trends

Wheat consumption in China has been quite steady of late but we should pay attention to a few finer details. It increased from 102 MT in 2006/07 to 122.5 MT in 2011/12, 20% in 5 years. If this trend had prevailed for another 5 years, now consumption would be close to 150 MT. However, over the next 4 years consumption actually declined to 112 MT; only due to a sharp pick up in 2016/17 that it recovered to 118.5 MT. This is still a fairly significant increase, 16% over 10 years, while the country's population increased by only 5%. Thus, per capita wheat consumption increased at close to 1% per annum, from 77 kg/year to 86 kg/year.

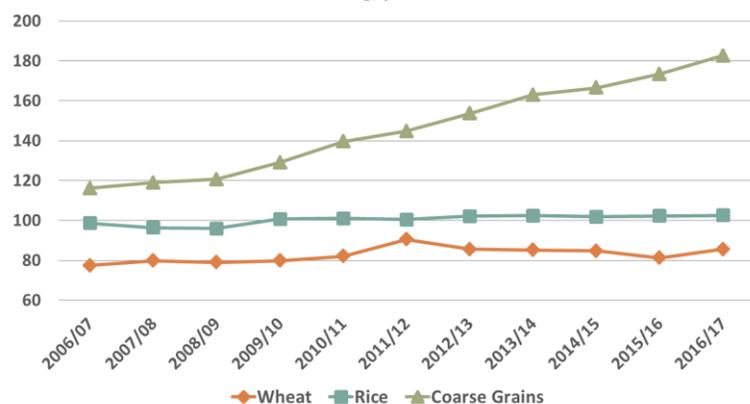
This rate of increase pales in comparison to China's GDP per capita, which doubled over the same period, or 7% per annum. It may not be an indication of a strong income effect on consumption, but cannot be dismissed if it were to be sustainable. In 10 years from now, China's annual wheat consumption would be close to 140 MT, 20 MT more than today. The income effect on wheat consumption is controversial (which we will get into later), but given China's size we would be amiss to ignore it. We acknowledge at the outset that income effect is not huge, and taken on its own may even be negative. But with development and concomitant rise in incomes, other effects come into play – such as rural-to-urban migration, shifts in culinary habits or traditions, or even the type or grade of wheat consumed.

Below we show wheat and rice consumption in China together with coarse-grains, which are mostly corn with some barley and sorghum in the mix. Wheat and rice are the main food staples (only 5% for animal-feed), which the Chinese consume in more or less same quantities on a per capita basis. Rice consumption has been quite steady over the years at 100 kg/year, while wheat is consumed somewhat less but on a per capita basis, increasing modestly over time. Per capita coarse grain consumption is higher with significant increases over the last 10 years, from 120 kg/year to 180 kg/year, but used primarily for animal-feed.

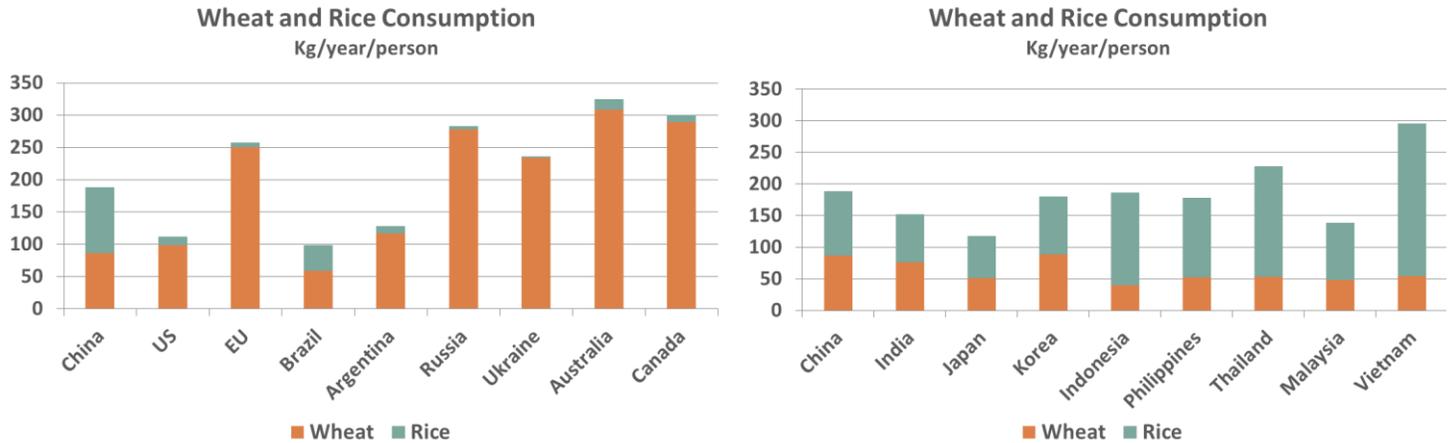
China – Annual Grain Consumption  
Million Tonnes



China – Per Capita Grain Consumption  
Kg/year



## China Wheat-Flour Supply-Chain



The above charts display per capita wheat and rice consumption for select countries around the world. The 8 countries shown on the left (all top-10 grain producers but India which is included in the Asian group to the right) are compared to China. Among them only Brazil is a significant rice consumer with almost 40 kg/year per capita; Australia, US, Canada, and Argentina consume in the 11-16 kg/year range, while EU, Russia and Ukraine even less, in the 2-8 kg/year range.

Among these nine countries China's per capita wheat consumption is only higher than Brazil's; the US and Argentina consume more than China but by modest margins (14% and 34%). EU's per capita wheat consumption is almost 3-times that of China's; Ukraine consumes 2.7-times, Russia 3.2, Canada 3.4 and Australia 3.6. It is interesting to note how much more wheat EU consumes than the US; at 250 kg/year it consumes less than Russia (278 kg/year) but more than Ukraine (234 kg/year). Australia (308 kg/year) and Canada (289 kg/year) consume more than all three, and in this regard are more *European* than *American* in their dietary habits.

There is a stark contrast between the two sets of countries shown above. The group to the left (excluding China) on average consumes 184 kg/year of wheat and a mere 13 kg/year of rice, while the Asian group to the right (again excluding China) consumes 67 kg/year of wheat and 99 kg/year of rice. The combined wheat-rice total of those to the right is 197 kg/year compared to the other group at 166 kg/year (in both cases excluding China) – China's total is 189 kg/year.

Among the Asian group China's per capita wheat consumption (86 kg/year) is above all the others but South Korea, and even then only slightly (2 kg/year difference). India's wheat consumption (76 kg/year) ranks behind China and the lowest in the group is Indonesia (39 kg/year) – the other 5 (Japan, Philippines, Thailand, Malaysia and Vietnam) all consume around 50 kg/year. Vietnam takes the top spot in rice consumption with 242 kg/year, followed by Thailand at 174 kg/year, Indonesia at 147 and Philippines at 126. The richest country in the group, Japan, has both the lowest rice (67 kg/year) and combined rice-wheat (111 kg/year) consumption, while the poorest, Vietnam, has the honor of being the highest on both counts.

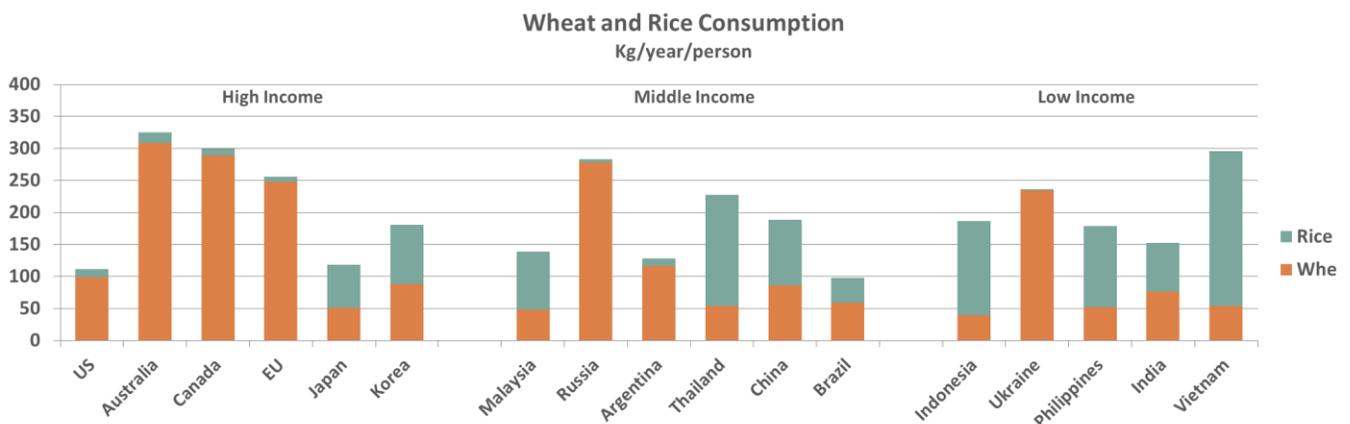
## China Wheat-Flour Supply-Chain

There is a commonly held, but incorrect belief that there is a strong relationship between income levels and grain consumption – that people will eat more until they overcome their hunger, but as they become more prosperous, they reduce their grain intake by substituting calories from meat, vegetables, and fruits that they can now afford. Other than the comparison we drew above between Japan and Vietnam, there is little in wheat-rice consumption patterns to support this belief. In the chart below we rank the 17 countries we examined above by PPP adjusted GDP per capita. There is no evidence of an income effect on either wheat or rice, or their combined total, and the effect seems to be explained by culinary traditions.

In the highest income group (\$37,000 to \$57,000 per capita) Australia and Canada consume 3-times more wheat than the US, who they follow on the income-ladder. EU consumes 2.5 times more wheat than US, but like all three above it in the income ladder consumes little rice. Japan and South Korea that are at comparable income-levels to EU, consume considerably less wheat, and even wheat-rice combined. These two high-income Asian countries consume less wheat than the US, but more wheat-rice combined (particularly South Korea, 60% more).

In the middle-income group, Russia has the highest wheat consumption (even higher than EU) but consumes very little rice. Argentina is the 2<sup>nd</sup> highest wheat consumer in the group (but only little more than the US), but like Ukraine consumes very little rice. Thailand is the highest rice consumer and 2<sup>nd</sup> highest behind Russia with rice-wheat combined; rice constitutes 75% of its total. China is the 3<sup>rd</sup> largest in wheat as well wheat-rice combined; though its income level is about the same as Brazil, it consumes more of both wheat and rice. All three Asian countries in the group have more rice in the mix, but Brazil consumes quite a bit of rice as well.

In the lowest income group Vietnam (at the bottom of income ladder) is the highest consumer of wheat-rice combined (3<sup>rd</sup> highest among all 17). All 4 Asian countries in the group have more rice than wheat in the mix, but Vietnam is by far the highest rice consumer. In total Ukraine ranks 2<sup>nd</sup> in the group but almost all with wheat; India is the lowest with wheat-rice combined (in equal quantities). This lowest income group has a combined per capita consumption of 168 kg/year compared to 197 kg/year for the high and 185 kg/year for the middle income groups.

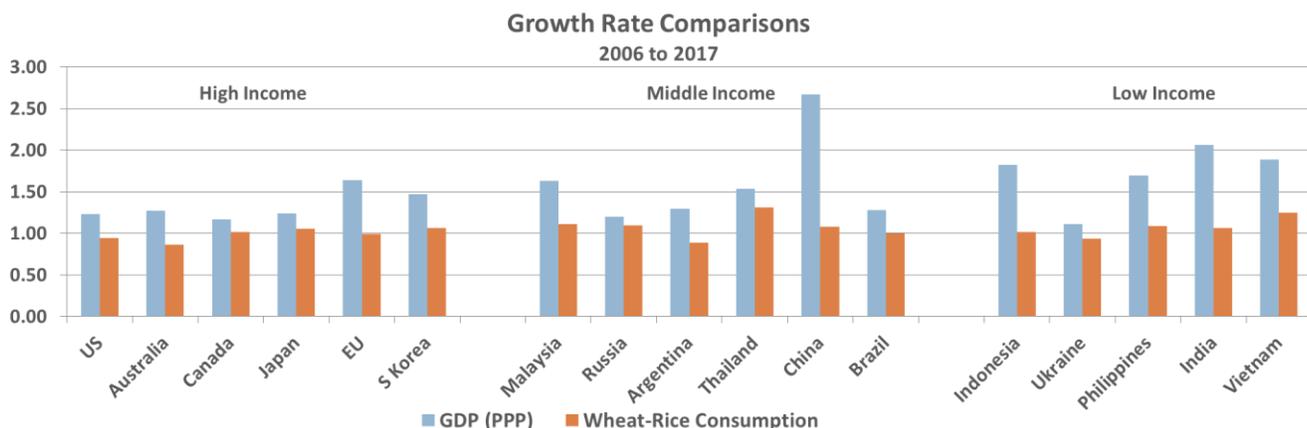


## China Wheat-Flour Supply-Chain

In the chart below, we compare GDP per capita (PPP) and combined wheat-rice consumption growth rates from 2006 to 2016, for each of the 17 countries we examined earlier. GDP growth rates are naturally more modest for the advanced economies, except for EU – but we should caution that growth may be overstated due to boundary and other structural changes as EU expands. Growth rates for the middle and low income countries in the western hemisphere (Russia, Ukraine, Brazil and Argentina) were not much better, but all the Asian countries experienced 1.5 to 2.0 times GDP per capita growth (including South Korea which can be regarded advanced). China was still above the rest with 2.7-times growth, followed by India.

Across the board combined wheat-rice consumption per capita increased but only modestly, 5% per year. There were actual declines in Australia (15%), Argentina (11%), Ukraine (6%) and (US (6%). The only significant consumption growth in the western hemisphere was observed in Russia, 9.5% -- exclusively from wheat. Consumption growth was more widespread in Asia – Thailand as much as 31% and Vietnam 25%. Malaysia’s consumption grew 11%, Philippines 9%, India 6.5%, South Korea 6% and even Japan 5.5%. Slowest growth rate among Asian countries was in Indonesia (1.3%), but wheat consumption grew faster while rice declined somewhat. Across Asia, though rice remained the dominant crop, most of the incremental growth was in wheat. As we saw earlier China’s rice consumption did not change much over this period, but overall per capita consumption growth was still close to 8%, naturally all from wheat.

As evident from both cross-country comparisons and last 10 year’s growth trends, there is little to support the belief that grain consumption (in particular wheat and rice) would decline with rising incomes. Consumption is growing albeit much more modestly than GDP per capita growth. Geography plays a key role in the wheat versus rice split, the latter more dominant in countries more conducive to rice production. But wheat consumption is growing faster in those countries where rice is the dominant crop. Also, we must acknowledge that local crop availability has shaped culinary traditions over centuries; still, wheat seems to be making inroads across Southeast Asia where rice has traditionally been the primary food staple.



There are a couple of other points to consider in assessing the future prospects for wheat-rice consumption in China. The country is divided along north-south lines; in terms of both production and consumption, wheat is the more dominant crop in the north and rice in the south. Per capita wheat consumption is 150 kg/year or more in some northern parts (national average 86) while rice consumption more than 200 kg/year in the southeast (national average 102). Also, while westerners generalize over Chinese-food, there are very different regional cuisines – with different local ingredients, some using more rice while others more wheat.

There is also a rural-urban divide; after decades of migration to the cities, now the urban population is larger than the rural. There are fairly sharp income differentials which give rise to different eating habits, be it due to disposal income or city-lifestyles. Per capita wheat-rice consumption is higher in rural areas, and there is a positive income effect, the higher quartiles eating more, but household surveys suggest a decline in per capita consumption. In urban areas consumption rates seem fairly flat over time with no appreciable difference between high or low income groups. Still, overall trends hold: flat per capita rice consumption, but increasing wheat consumption (10% in the last decade). The same modest trend could mean 10-15 MT of more wheat being consumed annually 10 years from now.

We do not put much stock in the direct income effect, but growth is still a critical factor; prosperity shapes culinary habits and opens entrenched traditions to external influences. In PPP terms China is already the largest economy, and with higher growth rates than most, in the coming years it is expected to overtake the US economy in nominal terms as well. China's nominal GDP per capita still ranks around the 70<sup>th</sup> in the country rankings – \$8,500 per capita compared to \$57,000 for the US, \$44,000 for Canada. In PPP-adjusted terms, China's per capita GDP is higher, \$15,500, but ranking even lower. We see no reason for China's development model to falter in the next decade or two; we believe China is going to develop and prosper, at growth rates perhaps not as fast as 10 years ago but more in line with the last 5 years.

This prosperous future paves the way for changes in culinary traditions, what and how the Chinese eat – even more radical than what we have observed in the last 20 years. Firstly, every part of China is opening to the culinary traditions of other parts of the country. Secondly, we see the foreign influences – Japanese, Korean and Thai restaurants, bakeries and pastry-shops at every corner. Fast-food may be the ugly-face of Western influence, but KFC and McDonalds pave the way to fancier eateries where their derivatives are served at many times the price, while pizzerias popularize fancier pasta-varieties. There is a lot of wheat content behind these trends, different kind of wheat than what China grows. What interest us most is high-grade wheat and durum that we hold strong export positions in. This is where the import prospects lie, as we will turn our attention to later in this report, after production and milling trends.

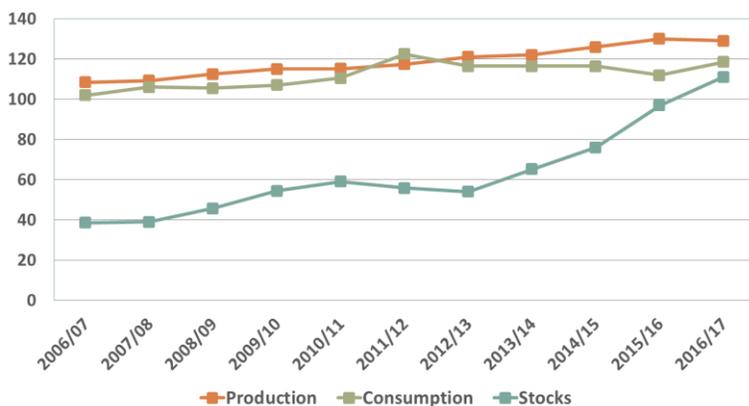
## Wheat Production Trends

In the last crop-year China produced 129 MT of wheat. There have been modest but steady increases over the last 10 years – generally ranging from 1% to 3% per year. More recently 3% per year appeared to have become the norm but in the last crop year production dipped slightly (by less than 1%), first decline in recent years. With the exception of 2011/12 when production fell 4% short of consumption, there have been modest surpluses, in the range of 3-7% but as much as 8%, 16% and 9% in the last 3 years (even with last year’s dip). In fact, last year’s production exceeded what OECD-FAO had projected to 2025 based on past trends.

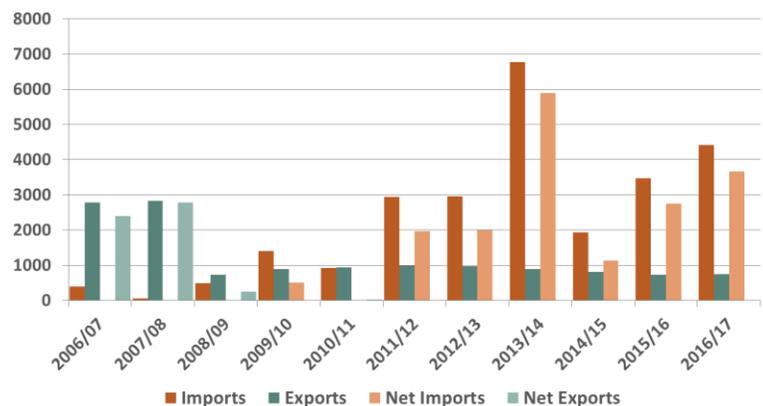
In the last 10 years domestic wheat production exceeded consumption by 65 MT, but an extra 15 MT was still imported (after 10 MT of exports). The surplus, roughly 80 MT, went to boost the country’s reserves. China’s wheat stocks now stand at 110 MT, almost 3-fold increase over the last decade – more than 40% of the world total with only 20% of the global consumption. Some blame this stockpiling on China’s hoarding instinct and fear China would one day dump these stocks to flood global markets. In reality China imports certain types of wheat that it is short of, and the low-grade wheat in its stocks is of little value to global consumers at large.

On the surface, recent trends suggest self-sufficiency in wheat, as important a food-staple as rice – what China’s food-security policies aim to achieve. But not all “wheat” is the same; different kinds or grades are required for different purposes to meet market demand. The grade of wheat that traditionally grew in China was sufficient for steamed buns, noodles and dumplings that constitute the principal calorie sources in rural areas, and also consumed widely in urban areas. Wheat flour for other uses like bread or pastries requires higher grades (high or low in gluten). To satisfy these new market needs, China has to revert to imports, and naturally from Canada’s export perspective this is where we focus – what China needs to import.

**China’s Wheat Production and Stocks**  
Million Tonnes



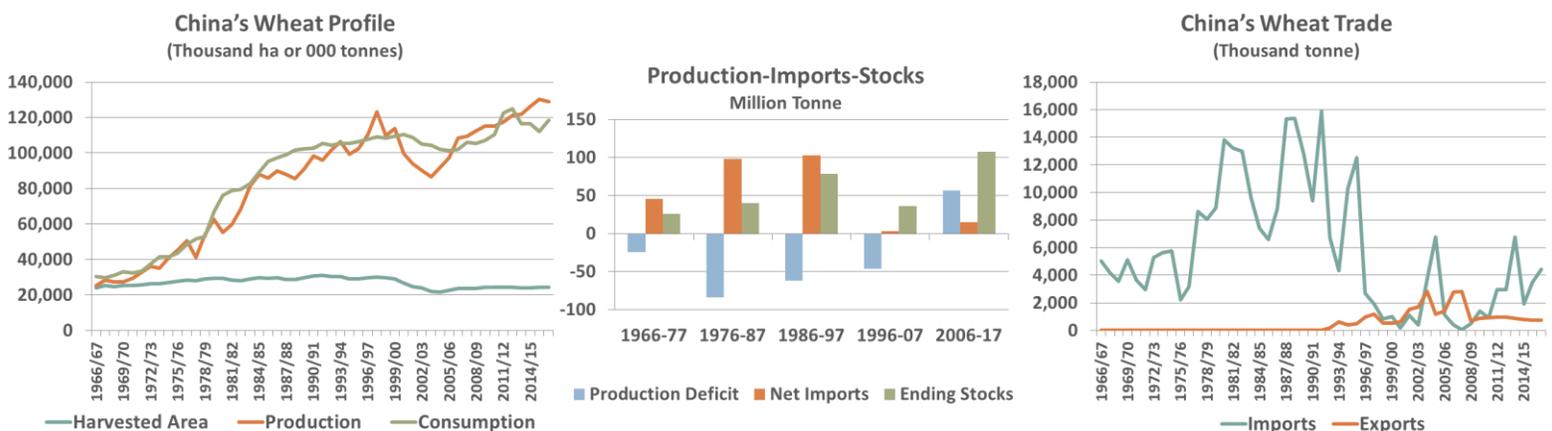
**China’s Wheat Trade**  
Thousand Tonnes



China’s achievements on the wheat production front look even more impressive from a longer historical perspective. Going back to the beginning of the reform era, China’s grain production in 1966/67 was merely 25 MT. The early reforms (collective farms with more freedom to act on their own) managed to double the production in the first decade, to 50 MT in 1976/77. In two more decades, with more inputs and mechanization, the output doubled again to 100 MT in the early 1990s. Today’s production is more than 5-times what it was back in 1966/67.

During the first decade (1966/67 to 1976/77) China’s wheat production fell 24 MT short; imports during this period were 46 MT, covering the shortfall and starting to build up the stocks (a mere 4 MT at the beginning). Into the second decade (1976/77 to 1986/87) the production deficit was a massive 84 MT, which was more than offset by 98 MT of imports, boosting the stocks by another 12 MT. Into the third decade (1986/87 to 1996/97) the production deficit was somewhat smaller, 62 MT, but even more were imported, 103 MT, doubling the stocks to 79 MT. Into the 4<sup>th</sup> decade (1996/97 to 2006/07) the production deficit shrunk further but still remained significant, 46 MT; this time China drew on its stocks, reducing them to 36 MT. In the final decade (2006/07 to 2016/17) a sizeable production surplus was achieved but a further 15 MT were imported, bringing the stocks to 108 MT – 104 MT stock build-up in 50 years.

In the first decade China’s wheat imports fluctuated in the 3-6 MT range and briefly fell down to 2 MT in the mid-1970s. In the next two decades imports increased substantially, averaging at more than 10 MT per year from the mid-1970s to the mid-1990s, with interim peaks at 15-16 MT. In the next 15 years imports moderated considerably, to an average of 1.5 MT per year – despite an interim peak close to 7 MT in 2004/05 necessitated by a production slowdown (25% drop in output in the early 2000s). Into the 1990s (as we will come back to later) the grade-mix of China’s wheat output had started to change, generating surpluses in certain types of wheat that could be exported while importing higher grades that were still in short supply. In the last 8 years annual wheat imports averaged above 3 MT, while exports remained below 1 MT.



## China Wheat-Flour Supply-Chain

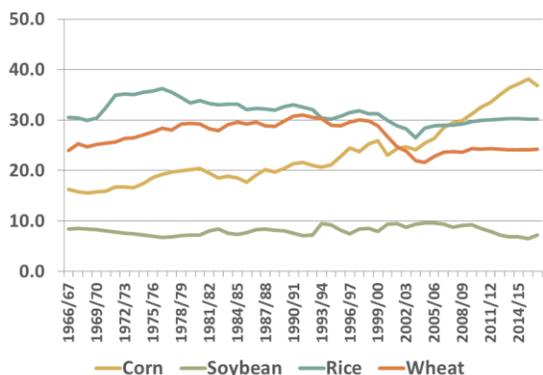
As the reform era got underway China had 24,000 ha of land allocated to wheat harvesting. This increased by about 25% during the first decade and stayed around 30,000 ha. Into the 2000s arable land allocated to wheat started to shrink and is now at about the original level, 24,000 ha. Thus, over these 5 decades the “production miracle” was achieved primarily through yield increases, from little more than 1 MT per ha to its current level of 5.33 MT per ha.

Needless to say, arable land is a scarce resource in China. With 20% of the world population China has less than 8% of the world’s arable land – about 0.08 ha per capita, compared to the world average of about 0.22 ha per capita. Though population growth has run its course, urbanization continues to encroach into agricultural lands. Total cultivated land is estimated below 120 Mha but continues to come under further pressure for development – grain production takes up more than 90% of this land allocation. Wheat takes up 24 Mha, corn 37 Mha, rice 30 Mha, soybean 7 Mha, and the rest is taken up by other crops (coarse grains and oilseeds). Over the 50 years land allocated to growing corn has doubled, soybean shrunk marginally, while wheat and rice remained the same – other grains shrunk by about half.

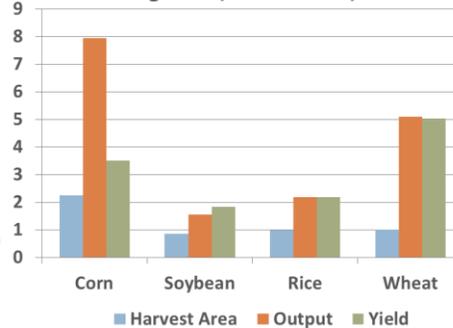
Yield improvements were not limited to wheat; they were experienced in all crop groups, but least of all soybean. With only 80% increase soybean was behind all other major crops; when coupled with 15% reduction in land, soybean output increased by only 55%. This was a deliberate policy choice since soybean is a low yield crop (1.8 MT per ha even with the 80% increase), held limited prospects for yield-improvement, and there were plenty of import choices – as discussed earlier, low cost sources from Brazil, Argentina and even US.

Rice experienced greater yield improvements, more than double from 3.1 to 6.9 MT per ha; with about the same land area, output also more than doubled. Yield improvements in corn were 3.5-times; with the land allocated to corn more than doubling, output increased 8-times. Still, of all the grains the rate of yield improvement (5-fold) was the highest for wheat.

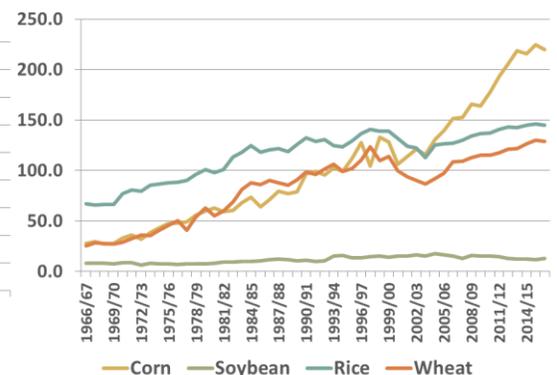
**Harvested Area**  
Million Hectare



**Change 2016/17 over 1966/67**



**Crop Production**  
Million Tonne

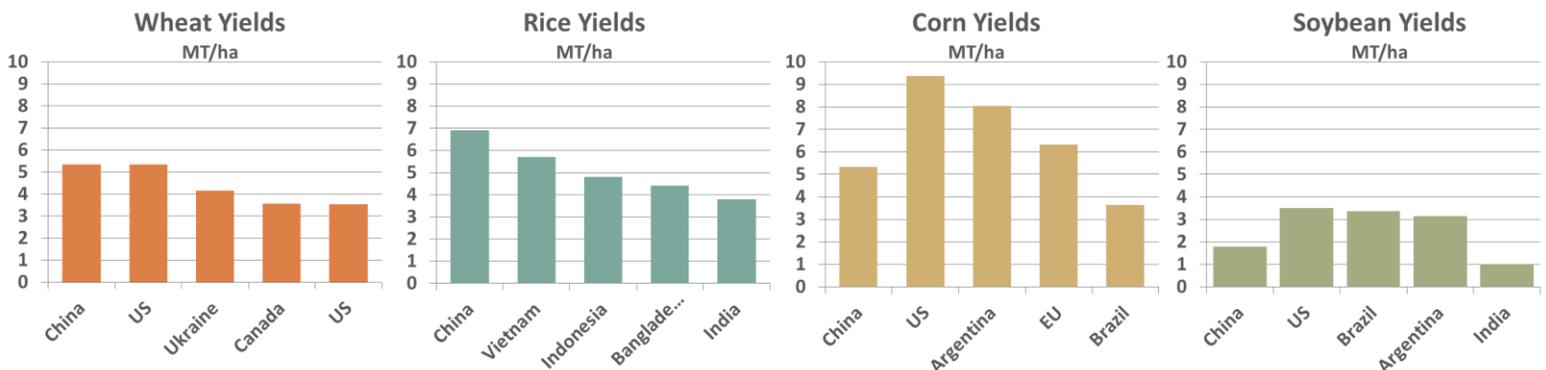


Soybean yield in China, 1.8 MT/ha, is fairly low compared to other major producers – US at 3.5, Brazil 3.4 and Argentina 3.2. But this is not a fair comparison as China grows high-grade soybean mainly for food-products, while relying on imports for feed-grade soybean. This was a conscious decision on the part of the government, mainly because there was no way for China to produce anywhere near what was going to be needed for feed, thus the decision to import.

China rice yields doubled and at 6.9 MT/ha already the highest among major producers – Vietnam 5.7, Indonesia 4.8, Bangladesh 4.4, India 3.8 and Thailand 2.8. In the last 10 years, China’s yield improved by 10%, less than India (19%), Vietnam (18%) and Bangladesh (15%), and dramatic increases in the foreseeable future are unlikely. With per capita consumption fairly steady, the status quo will probably prevail. Given the crop’s “status”, China will undoubtedly protect rice-fields from any encroachment, unless there are unexpected yield increases.

Corn production in China is an interesting case; given twice as much land, yields have increased 3.5-fold and output 8-fold. At 6 MT/ha (only 5.3 according to USDA) China’s yield is still behind US at 10, Argentina 8 and EU 6.3, though higher than Brazil at 3.6. China’s output of 220 MT is still far behind the US at 385 MT but more than double that of Brazil. If yields could improve to the US level, China could produce 350 MT – even more than the US if USDA yield is correct. If last year is an indication, there will not be any more land allocated to corn, but even a 10% yield increase would eliminate the current import. Corn is not a food-staple in China but an important source of animal feed – more so than soybean and China is more self-sufficient in it.

In wheat China achieves the same yield level as EU, 5.3 MT per ha, but is above all other major producers – Ukraine is the closest at 4.1, followed by Canada at 3.6 and US at 3.5. The only countries above China and EU are New Zealand (9.1), Namibia (6.5) and Egypt (6.4) and Mexico (5.3). Argentina stands at 3.3, Brazil 3.2, India 2.9, Russia 2.7 and Australia with 2.6 at the bottom among the top-10. It is not clear how much room there is to increase the average yield; anyway, China’s priority would be to increase quality rather than quantity. Land is too precious when there are import options – especially since China has already achieved “food-security”.



In tandem with its efforts to drive up yields, for all grains but particularly wheat, China has also been trying to improve crop quality standards. A big effort was made in the late 1990s to streamline and upgrade quality standards for different types of wheat grown in different parts of the country, both strong and weak gluten varieties. The three principal grain-zones were targeted – strong gluten in the northeast (along Kinghan Mountain Range) and the central-grain-zone (Shandong-Henan-Shaanxi provinces along Yellow, Huai and Hai Rivers), and weak gluten further south (corridor that stretches east-west, Jiangsu-Anhui-Hubei provinces). Now the focus is to cross-breed new wheat varieties suitable for growth in these regions.

It was estimated that into the mid-2000s areas sowed with quality seeds had increased from less than 5% of all land allocated to wheat to more than 30%. The efforts continued with another drive to implement modified standards in the latter part of 2000s. There is no doubt that overall grain quality has improved, but unlike yields that are easy to measure, it is difficult to quantify and verify quality improvements. As impressive as the achievements might be, however, it is certain that quality standards are still lagging behind what the market demands.

Land supply is a severe constraint on agriculture in China, which we emphasize throughout, but water shortages and greenhouse emissions are equally worrisome. With 20% of the world's population, China has only 8% of arable land, but even less fresh water, 7% and some claim as low as 5%. Rice production takes up 40% of all irrigation water usage worldwide; wheat ranks second, requiring 4-times as much as corn and close to 10-times as much as soybean, next two largest water-consuming crops – as we examined, all four have significant land-prints in China.

On the greenhouse front, concerns over coal and other fossil fuels overshadow emissions from agriculture, but the magnitude is more significant than generally recognized or acknowledged. In this regard threats posed by rice-fields (mainly methane emissions) are even more glaring than in the case of water. Worldwide, carbon emissions from rice (1.3 Mt CO<sub>2</sub>-equivalent) are double the next two biggest offenders, soybean and corn, combined. Wheat accounts for less than half of either of the latter two, but all grains combined constitute a significant source.

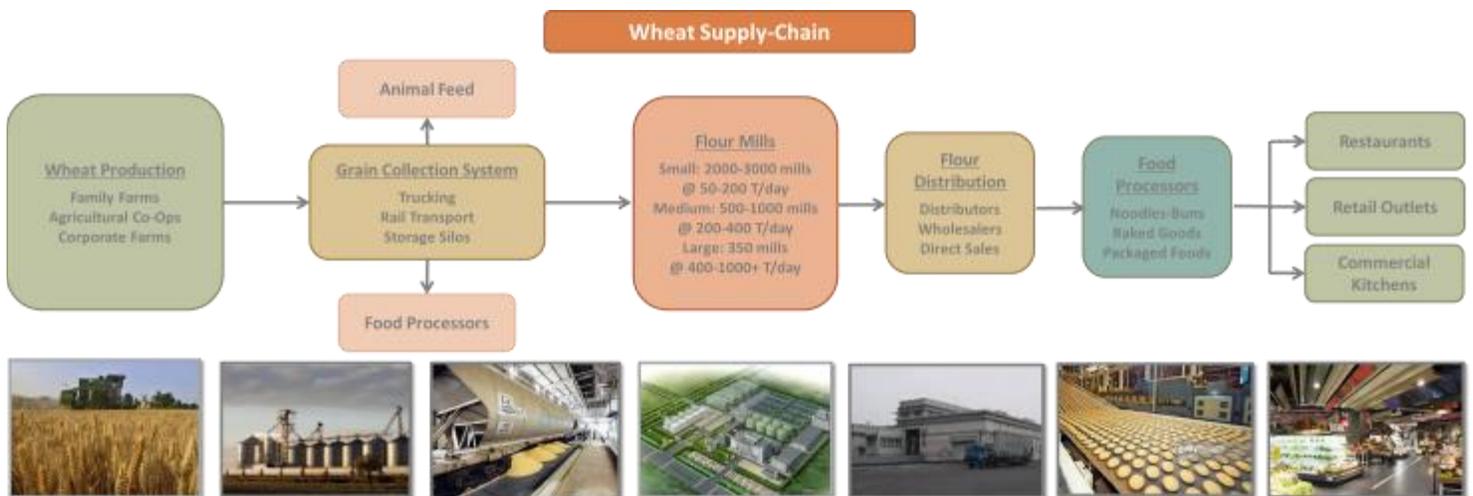
China gives utmost priority to food-security, and to that end pursues a policy of self-sufficiency in at least rice and wheat, and to a lesser extent corn. But facing other challenges like limited land supply, water scarcity and climate change, China is open to compromises. As long as a certain degree of food-security is achieved, it is open to import options, as it has proven over the years with soybeans. Wheat ranks far ahead in policy priorities, but China will not flinch on importing not just 10% but perhaps 20% or more of its wheat requirements, particularly when there are both price and quality advantages – as there are in high-grade wheat varieties. With huge trade-surpluses and foreign-reserves, China has ample ability to import plenty more.

## Flour Milling Industry

The next link in the wheat supply chain after production is milling. Large milling companies have their own procurement channels, working through intermediate traders or buying direct from producers. Some of the largest among them are in the production end of the business as well, with large corporate farms of their own or producer co-ops under contract to them. Small producers tend to deliver to local mills nearby, which there are plenty of across China – leftovers from the collective era or the Town and Village Enterprises that followed. One way or the other 100 MT of wheat end up at flour mills – residual going to seed-supply for next year’s harvest, into the animal-feed-chain, or to food-processing plants that take in raw grain.

China’s vast flour milling industry is highly proliferated with more than 4,000 mills and ridden with overcapacity – annual capacity at more than 250 MT but actual grind only 85 MT. More than half (perhaps as many as two-thirds) are small mills with less than 100 T daily capacity. There are 5,000-1,000 mills in the medium-range with daily capacities varying in the 100-400 T range. There are about 350 above 400 T/day but even that threshold is small in today’s standards; modern ones that are being built can grind more than 4,000-5,000 T per day. The larger mills achieve better utilization but most if not all still have some capacity to spare.

With so much excess capacity and inefficiency, it is not surprising to see the milling industry consolidate, to the chagrin of small operators and delight of industry giants. The excess capacity is largely the industry’s heritage, a plethora of small scale mills built over time to grind the locally grown grains, initially owned and operated collectively and in time taken over by budding rural entrepreneurs. A few had the vision to scale up and modernize but most got left behind due to limited know-how or resources to adapt to the new ways – scale and modern technology. More than 2,000 mills across China are idle or at best poorly utilized, barely covering their costs, with their salvage value limited to the land value they sit on.



Material costs (wheat intake) make up 80-85% of the value of the flour; production cost margins are 15-20%, including capital (4-6%), operating (3-6%) and distribution (5-7%) as well as a narrow profit margin (3-6%). The scale-factor makes technology adaptation and automation possible, at lower cost with huge quality advantages. First, higher extraction rates can be achieved, thus more flour output from a given wheat intake. Second, grading, mixing, cleaning, and purification become easier and more effective. Third, flour can be produced with the desired particle-size, ash-content and other attributes most suitable for the end purpose.

Perhaps some of the advantages that come with technology (grading, cleaning, purifying and mixing) would not be so important if wheat supply was more reliable and consistent, but that is not the case in China. There are limited controls to ensure quality standards up the supply-chains; local grains are not subjected to the same scrutiny as imports, both at origin and inbound customs. Large wheat-processing companies have an advantage in that they have the market power to control suppliers, including domestic ones. Smaller, independent mills have to accept what is delivered to their mill-gate, but they have the advantage that the uses they produce flour for are more forgiving in quality – an issue we will come back to later.

China never lacked the agronomy knowhow but advances in milling technology and machinery are fairly recent. The evolution of these developments can be traced through four stages. The first period (1950-1980) is characterized by break-and-reduction systems at high extraction rates but producing high ash-content and large-particle flour – slow, low-volume but requiring little power. During the second period (1980-2000) milling became more energy-intensive; extraction rates deteriorated but in terms of particle-size the flour became more refined.

The third period (2000-2009) brought about marginal improvements in extraction rates and ash-control but the main focus was on energy efficiency. The most significant development in this period was the emergence of local manufacturers, in the same class as world leaders like Buhler. In the fourth period (since 2000) Chinese manufacturers (as well as design-build companies) became more dominant on the global scene with new equipment offerings and control systems – purification, ash-control, particle size control, yield improvements, etc..



With their latest mega-mill designs (500-800 T/day capacity units, sometimes installed in multiples at a given plant-site), China's leading milling technology companies have now become principal suppliers to the largest domestic milling-groups as well as exporters to global markets (Asia, Africa, and South America). The largest milling group in China (Wudeli) has long relied on local technology but now a much larger, diversified and integrated grains company (COFCO), using Buhler systems in the past, also started to opt for locally designed-manufactured systems.

China has now become a global-hub in milling technology. Even the global leader, Buhler, the oldest and most advanced company in this sector, uses China as its principal manufacturing base. While Buhler is highly integrated (equipment and control systems) the Chinese industry is more segmented with 30 or more specialized players. The turn-key design and integration functions are shouldered by companies like Golden Grain and Zhixin, serving the domestic milling industry as well as export markets. In the last 20 years China sold 200 smaller mills to Africa (20-100 T/day), and more recently larger turn-key projects (200-500 T/day) in East Asia.

In the last 10 years China manufactured and installed 100 milling-lines a year, 1000 in total – grind-capacity of 10,000-15,000 T daily and 30-45 MT annually. These new milling lines, if all installed in China and fully utilized, could now grind 35-50% of China's flour needs (85 MT), but with older mills still producing, their share is only 25-35%. Now there are about a dozen mega-mills – some 5,000-6,000 T/day, others 2,000-3,000 T/day, with a combined capacity of about 15 MT. In the next few years the number of mega-mills could easily (in all likelihood will) double, 20-25 mills with a capacity to produce 35% of the flour China now consumes.

According to some estimates the largest milling group in China, Wudeli, has the capacity to grind more than 60,000 T/day – largest North American milling group Ardent has less than half that. The other two large groups, Yihai and COFCO, together are as large as Wudeli. Though these three industry leaders achieve much higher capacity utilization, their combined market share is estimated around 25% – at full capacity they could achieve 40%. In the coming years these industry leaders are expected to continue their expansion by building more mega-mills.



## China Wheat-Flour Supply-Chain

It is evident that the gears are in motion for the milling-industry's consolidation, but still there is a huge capacity-overhang that seems to persist. Currently, the over-capacity is roughly 165 MT – total capacity-estimate of 250 MT less 85 MT actual grind. New mega-mills are being built but the older, smaller mills are not closing at anywhere near the same rate – they remain registered, mostly idle or dormant, or at best underutilized. In view of the cost and even more significant quality advantages, the large advanced mills bring, why are the old ones persisting?

As we pointed out earlier, production costs at the milling stage represent 15-20% of the flour's value; the material costs (i.e. wheat) are much more significant (80-85%) and embedded in that portion are the costs of transporting the wheat from farms to flour-mills. This latter item is highly variable by distance as well as available transport-options (truck or rail) from wheat-growing areas to mills. These transport costs vary much more than milling cost-differentials. Producers naturally want to deliver their crop to the nearest destination where they can get paid. That could be a nearby storage facility or a flour-mill, small or large they do not care. China does not have a well-developed grain-collection system with truck (B-train bulk trailers) or rail options (hopper-cars and unit-trains) like the ones we are accustomed to in Canada.

Many old mills across the country have more or less captive producer catchment areas. If there are no mega-mill options nearby, wheat gets delivered to their door-steps. The higher milling costs are offset by inbound transport cost savings; many small mills continue to churn out flour regardless of their grinding-cost handicap. Of course, cost-savings that come with scale economies are not the only benefits of advanced technology; process and product-quality advantages are even more significant. For many end-uses, flour quality (and particular attributes) is all-important, but not for traditional uses like making steamed bread or buns, not even for a vast array of noodles and dumplings for everyday consumption, particularly in rural areas where people are used to old flours. These are the markets that old, primitive mills cater to. With most of their costs already "sunk", they hang-in even at very low utilization rates.



## China Wheat-Flour Supply-Chain

Above we depict two channels leading to very different types of flour mills, primitive-small ones from a past era, and advanced-larger mills built more recently. Most wheat farms in China are small in North American standards but some even more so than others, deploying primitive means to produce lower grade crops. In most cases they do not have access to railways or even large bulk-trucks; they use whatever means available (typically old farm-trucks) to get their crop to the nearest mills, which also tend to be small and primitive. These are the smaller mills that produce lower grade flour for traditional, often rural uses.

More advanced wheat farms – still small family-units but part of co-ops – are more mechanized and have the means to access large flour-mills, or at least grain-storage depots that feed the grid that leads to major mills. The more advanced mills (including recent mega ones) feed off this system – what we depict as the *high-end wheat-chain*. The flour produced at the end of this chain may also be for traditional purposes but is of a higher and consistent quality aimed at the intended purposes. The input into this chain incorporates imported varieties in the mix.

The milling industry’s consolidation is driven by the *high-end*, but even after a decade of building the world’s largest mills with advanced milling-lines (1,000 built, installed in 10 years) the industry is still highly proliferated with huge excess capacity (165 MT). When the largest ones can grind 5,000 T/day, less than 10% of more than 4,000 mills in China are larger than 400 T/day. Even with huge over-capacity (almost double consumption) pace of consolidation is not picking up – small mills are not going away as they are adequate for lower-grade flour.

We estimate the annual capacity of the large mills (above 400 T/day) at about 80 MT (1/3 of the total) but not fully utilized as that is close to total consumption. In 10 years we project another 20-30 MT of annual capacity through new mills, while consumption grows by 10 MT (less than 10% in 10 years). At this level China should be targeting a total capacity of about 150 MT, which means most mills smaller than 400 T/day (more than 3,000) should close down, leaving behind 50 MT at the small end but with advanced-lines to cater to niche markets.



### Wheat Import Outlook

Let us first recap the consumption and production trends we examined earlier. China's wheat consumption increased 16% in the last 10 years. There was a partial (5-6%) population effect, but still per capita consumption increased by 10%. China consumes more wheat per capita than most of East Asia, at 86 kg/year only behind Korea at 88 kg/year. Compared to other major wheat producers, however, China's per capita wheat consumption is still low, only slightly below US but mere 30-35% of EU and Russia, 25-30% of Australia and Canada.

In the Asian context we must also look at the combined wheat and rice consumption, as these two together make up the main food-staples. In this regard China, Korea, Japan and India consume similar quantities of wheat and rice – combined per capita consumption is the lowest in Japan, slightly more in India but not as much as China or Korea. China's rice consumption per capita has been flat but at a lower level than most others in the region – Vietnam consumes 140% more, Thailand 70% and Indonesia 40%. In countries where rice is more dominant, wheat consumption per capita has been on the rise, in some countries more rapidly than in China, but there is no evidence of a substitution effect – more wheat is consumed in addition to rice.

As discussed earlier, we do not put much stock in the negative-income-effect hypothesis, that as incomes rise people switch from rice and wheat to other calorie sources (meat, fish, vegetables and fruits). Some of the richest countries consume much more wheat; the US appears an exception but here there is also the corn-effect to consider as a second staple instead of rice. Wheat consumption is higher in Russia and Ukraine than EU where incomes are higher, but below more affluent Canada and Australia. In China wheat consumption is lower in the cities than in rural areas, which one could postulate is a negative income-effect, but there is no evidence of this effect among urbanites while there is a positive one in rural areas.

Food consumption is largely dictated by culinary traditions, which in turn are shaped by locally grown crops and other ingredients. Income has an effect on what people eat as they can afford new and different varieties, including foreign ones that they were not exposed to or could not afford before. Culinary habits change and evolve with more affluent lifestyles, but “staples” do not go away; the way they are used or cooked, however, do change. Regardless of how strong and entrenched its culinary traditions are, China is not an exception in this regard.

Regional culinary traditions are very diverse across China but as the country prospers locally distinct culinary habits spread to other parts – wheat to the south, rice to the north but the overall effect more or less evens out. Average rice consumption has been stable but wheat consumption per capita increased by 10% in the last 10 years and is likely to increase by yet another 10% in the next 10 years – note that 10% increments are 10-15 MT a year.

While annual wheat consumption grew 4-fold in the last 50 years, production grew 5-fold. China faced an overall production deficit of 160 MT over this period, most significantly from 1976 to 1997. The deficit was covered by 250 MT of imports in the first 3 decades (from 1966 to 1997), which also left behind enough to build huge stocks of wheat (79 MT). There was still a production deficit during the fourth decade, which was covered mostly by drawing on reserves with minimal imports. In the last decade the deficit turned into a surplus (64 MT), the first time in the reform era, but China continued to import (17 MT) increasing its reserves to 108 MT.

On the production front we should note that the land-area now allocated to wheat is the same as 50 years ago. Production expanded due to remarkable increases in crop yields – for all grains over this period but particularly wheat. Looking at the long-term trends one may think that there is scope for further yield improvements, but China is already at the high end of the global scale, achieving higher yields than other major producers – only EU is at the same level. Thus, it is unrealistic to expect much more from China in this regard. On the other hand, land is scarce and agricultural production in general is severely constrained by water scarcity and concerns over carbon emissions. Accordingly, prospects for further production increases are grim; if anything, there will be pressure to curtail wheat production in the coming years.

Earlier we had discussed the roots of China's obsession with food-security, and to that end its commitment to self-sufficiency in rice and wheat supply. Early in the reform era, nobody outside China believed that this was achievable, and indeed through the 1980s and 1990s China had to rely on imports, some years as much 10-15 MT (or 10-15% of its consumption). At the turn of the century, self-sufficiency in wheat became a reality – modest imports offset by exports, with a net export position close to 1 MT through the first decade of the century. Then the trade balance turned again to net imports – total of 15 MT in the last decade.

In the last 10 years China produced more wheat than it consumed (64 MT-surplus). If we add net imports (15 MT) to this, the grain account for the decade was in a 79 MT surplus, which went into the reserves. The need for imports arises from better quality wheat varieties that are in short supply, even after a long and concerted effort to improve crop quality across the board. The need for exports results from the surplus of lesser quality wheat for which there is an external demand for in the region. The trade balance is dictated not just by the quantities produced and consumed, but also the type of wheat required to meet market demand.

Our outlook for the next 10 years calls for modest increases in consumption, while pressures to curtail grain production in general (wheat included) will continue due to land scarcity and environmental concerns. These trends point in the direction of more imports, mainly high grades of wheat which are easier to source elsewhere than to grow in China. China's annual wheat imports can easily increase from 4-5 MT in the last few years to 10-15 MT or more.

## China Wheat-Flour Supply-Chain

Throughout the reform era (particularly in the last 20 years), in tandem with the *production-drive* to increase yields, China also embarked on a *quality-drive* to improve the grades of wheat produced across all major wheat growing regions. The quality-drive came through improved farming methods (mechanization through capital investment) as well as seed quality (more recently, cross-breeding foreign seeds with local ones). Some would argue the results in quality improvements were as impressive as yield increases, but the efforts still fell short of global standards set by leading wheat exporters like the US, Canada and Australia. And it could be argued that the efforts also fell short of the quality levels domestic markets are demanding.

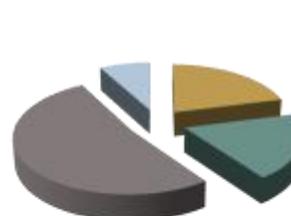
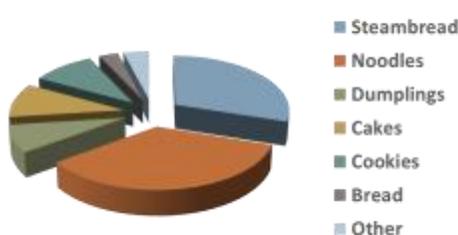
Of course, wheat is not the final consumption product; the improvements in the next link in the supply-chain, flour-milling, was the other dimension of the quality-drive, in many respects more important than crop quality itself. Quality improvements throughout China's food-chains over the last two decades are evident from not only in food-processing industries but also the radical changes in the flour milling industry – automation and new technology adaptation as well as consolidation. The improvements that have been achieved in flour-quality in China are quite staggering, across the board as well as targeted at specific purpose flour varieties.

In order to relate to these changes, it is important to understand where flour is used. As evident from the chart below, there are huge differences between China and the West in this regard. Traditional Chinese foods – noodles, steamed-bread and dumplings – account for close to two-thirds of flour-use. While bread-making takes up more than half in the West, its share in China is a mere 3-4%; cakes and cookies account for 40% in the West but half that in China.

Traditional flour-uses are much more forgiving of lesser quality wheat-flour, as long as all-important white-colour requirements are met (dictated by ash-content). Even the small, primitive mills can meet this demand, particularly in rural areas where most of these old mills are located – as we discussed earlier this is why these mills still stay open in the face of competition from large, advanced mills. This grade of wheat-flour is inadequate for baking – be it bread, cookies or cakes. In baking, still a very small share of flour use in China, flour quality is much more critical, in terms of particle-size, protein-content and other product attributes.

Wheat Flour Use - China

Wheat Flour Use - US



Technology brings huge advantages to the milling process, not just in terms of higher extraction rates and fuel efficiency but also cleaning, blending, and purification capabilities. Automated processes allow the mill to control (for each milling-line) the wheat-mix best suited for the intended flour-use as well ash-content and particle-size. Also, advanced mills have quite a bit of tolerance in their wheat intake by being able to clean, remove impurities, and sort different grades. They can take most of what comes their way, even from the low-end wheat-chain.

If the flour demand profile stayed the same, the milling industry already in place can live within the confines of China's current wheat supply with minimal imports (sub 5 MT annually). The industry will continue to consolidate with advanced mills, which no doubt will expand their capacity and market share, and further improve the quality of flour produced for traditional uses. However, flour demand will not stay the same; major shifts are already underway and will gain momentum in the coming years, increasing demand for imported wheat varieties.

In this regard, we should bring attention to two particular trends that the local wheat supply will have difficulty accommodating. The first market segment to focus on is the bakery industry, which is growing at 15-20% a year with both domestic and foreign bakery chains expanding their footprint all across the country. All sorts of western-style pastries are becoming popular and widely consumed, but the most significant trend is the bread-revolution. China grows both higher and lower protein wheat that in principle could cater to the demand for regular breads, cookies and cakes, but local flours are not adequate to fuel the growth in high-end products. There is scope for imported wheat at this end of the market.

The second market segment that deserves attention is western-style pastas (distinct from local noodles) and flat-breads. The legend (or myth) has it that Marco Polo introduced noodles to Italy, but now the Chinese have taken to Italian food with a vengeance – pizza chains (low and high end) are spreading like wild-fire while Italian restaurants are popping up virtually in every city bloc. Pizza or pasta looking foods can be found everywhere, but anybody who takes pride in cooking or eating struggles with what can be made from local flours. Currently this market segment can best be characterized as niche or artisan, but as the mass market develops, major flour producers are turning their attention to it with high grade wheat input requirements.



The advanced mills we examined earlier consist of multiple milling-lines which can be configured (in terms of wheat intake, process and flour attributes) to produce specific products. For example, at one of the mega-mills (5000 T/day) 5-lines devoted to flour suitable for pasta-making (500-750 T/day) could grind 150,000-200,000 tonnes a year. As we expect flour requirements for the quality-bread and pasta-pizza markets to grow to 15-20 MT annually, there could be as many as 100 production lines (5-lines each) engaged for this purpose.

This output could be spread over a number of large mills (which we forecast 350 of across China) or more concentrated at medium-size mills equipped with advanced technology (existing or retooled). These specialized milling lines will not be fed entirely with imported wheat; in all likelihood a quarter of the intake would be imported, blended with high-grade wheat varieties grown in China. At 25% of imported wheat content, a 15-20 MT flour market segment could require more than 5 MT of imports – half the total if China was importing 10 MT a year.

To put these numbers in perspective let us refer to our wheat exports to China; though some years we had exported more than 2 MT, last year's export volume was only 360,000 T. Fewer than 10 mills with specialized flour lines (5-lines each, importing 25%) could have taken up all our exports last year. To date we have not exported any durum to China, a variety we are renowned for and an essential pasta-ingredient. To Italy, a major pasta market, we export 700,000 T of durum a year. As the Chinese market matures, even at one-twentieth of Italy's per capita consumption rate, we would have a durum export market larger than 1 MT to go after.

As these new market segments develop in China, demand for high-grade wheat will emerge in global trade markets and no doubt some of the opportunities will trickle down to us. After all, we would be one of the principal contenders – others being US and Australia. Of course EU is the largest wheat producer but many European countries are already buying wheat (particularly durum) from us. With the newly strengthened rail links Russia has also started to target grain markets in China, including wheat, but for the grades and varieties involved here Russia is an unlikely contender for China's expanded wheat imports. China can also grow more of the type of wheat these emerging flour uses require – no doubt requiring improved seed cross-breeding practices, but this is not beyond China's means. However, there are perennial land constraints together with water-scarcity and other environmental concerns. China is more amenable to imports than expanding any kind of grain production domestically, including wheat.

It is in our best interest to jump the gun and cultivate strategic relations with leading flour mills – the three leading milling groups as well as others interested in getting into specialized flours suitable for these new market segments. These strategic efforts will require a willingness to get into long-term production contracts as well the logistics capacity to deliver containerized wheat shipments to flour-mill gates. Potentially this is a 5 MT a year or more export opportunity.

### Our Wheat Export Prospects

Looking at our wheat exports to China over the last 25 years, whether as a share of their imports or share of our exports, we clearly observe an erratic pattern, driven by opportunism on both sides. This is indicative of most bulk-trades we engage in, with little evidence of a strategic effort to sustain let alone grow export volumes. When our trade-relations were much better our share of China's wheat imports was an order of magnitude higher, as high as 70% some years compared to less than 10% recently, mere 2-3% of our wheat exports.

Now that our trade relations are at an all-time low, it may sound pointless to be talking about growing our wheat-exports to China. But let us still look at the opportunity by assuming that we can mend the relationship to go back to the way it was a few years ago when China was our largest export-destination, taking 20% of our exports, the same as China's share of global grain trades. Or let us treat this as a hypothetical case-study we can learn from as if we were considering the wheat opportunity a few years ago before the trade-relations soured.

China is now one of the two largest wheat producers in the world, just behind the EU. Earlier in the reform era it was a net wheat importer to meet its consumption needs. As result of persistent yield-increases, it became self-sufficient into the new century. But it continued to import to build up its stocks, now the largest in the world – 40% of global-stocks, enough to cover almost an entire year's consumption. And as we noted earlier, given that China's per capita wheat consumption is still low in global standards, there is room for growth, albeit slowly. But given the size of the market, 120 MT/year, even less than 1% annual growth could give rise to 1 MT of more imports every year, as domestic production is unlikely to increase.

Rather than this aggregate growth, however, we should be focusing on the types of wheat China needs driven by consumption trends, growing appetite for bread, pastries, and pastas that require higher grades of flour, in turn requiring high quality wheat varieties that we are known for – particularly hard-red and durum but also soft-white. But rather than through traditional bulk-trades, we must pursue these opportunities by targeting strategic buyers, large milling groups we identified earlier as well as boutique-mills with containerized IP-shipments.

We believe there is an opportunity to cultivate a market for at least 5 MT/year of high-value wheat exports. If we could achieve this, we will not only be maintaining but even growing our China-bound exports, about 8 MT/year before our trade-relations soured. Also, this would achieve a much healthier balance in our export-mix which previously consisted of close to 4 MT of canola, almost half of our grain-exports to China (90% of China's canola-imports). Even if we were to replace all our canola exports with high-value wheat varieties, we would be achieving a healthy shift in our export portfolio by reducing our vulnerability in global canola markets.