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Population pressure

8 billion by 2020, a dominant driver of commodities

When Neil Armstrong walked on the moon in 1969, he looked down at a world with just 3 billion inhabitants. Fast forward four decades to 2020, and the world's population would have grown to 8 billion – certainly one giant leap for mankind. At the current growth rate, 9 billion people could be walking the Earth by 2030. Following on from our recently concluded Earth's Resources Conference, we release this detailed study on the rising pressures from Earth's growing population and the likely impact on commodity prices. This report continues from the extensive analysis by Gerard Lyons and team presented in their 2010 The Super-Cycle Report, which highlights the long-term implications for global commodities. A growing population – and one with a rising ability to spend – promises to become an even more important driver of commodity prices than the consumption impact China wields currently.

The world's population could reach 7.2 billion by the end of this year and 8 billion by 2020, with the largest increase to come from Africa, such that the continent could overtake both India and China in the next 10 years. We estimate Africa's population to reach 1.4 billion by 2020 from 1.1 billion now. Indeed, as highlighted in our *Super-Cycle* report, Africa's growing population could contribute to what we had called "an arc of growth" stretching from China through India and into Africa. The population on the African continent is growing five times faster than China, and it is the youngest in the world. Moreover, it is relatively free of consumer debt and boasts a swelling middle class.

Soft commodities are likely to be beneficiaries in this new age, with palm oil, corn, soya and sugar to rise on the cusp of major new bull markets. To feed the large population, we need to find new agricultural land that is larger than the farms in India or Russia. The emergence of producer power comes at a time when China seems to be more reliant on food imports. We could be one bad season away from another spike in food prices.

Copper and gold could be the big winners in the metals arena. Supply constraints in these commodities are unlikely to ease as the world's population becomes increasingly hungry for these two metals.

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Executive summary

Africa – a key commodities driver in the next decade

Africa is emerging as a new powerhouse

The past decade has been about China's rising consumption of commodities that investors have been so engrossed with China's five-year plans and not noticed the quiet rise of the African continent. Its middle-class population has grown from 190 million to 320 million over the past 10 years and it has the youngest population among the three most populous regions in the world (China, India and Africa). Africa's population is rising 5 times faster than China's, which it is likely to overtake in the next 10 years.

Soft commodities – the likely winners

Producer power is on the rise

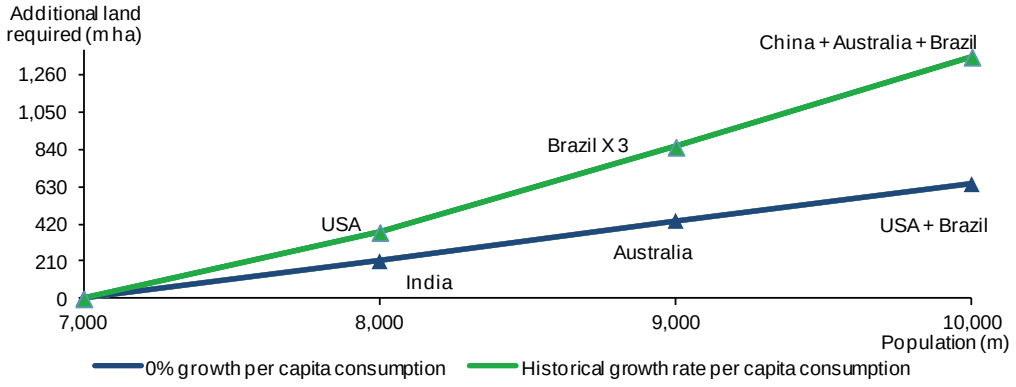
Farmers largely missed out on the China-led commodity bull market since 2002. If one were a corn or a soybean farmer in Iowa or a palm oil plantation owner in Malaysia, one would have been lucky enough to enjoy decent price gains over the last decade. But these price increases were overshadowed by the 600-plus% spike in iron ore and coking coal prices during the peak in early 2008. For the average farmer who produced rice, beef, potatoes, coffee or cocoa, times have remained relatively tough. In reality, many soft commodities are well below their 1981 prices adjusted for inflation. Low profit and urbanisation have led to a mass exodus of farmers globally, resulting in the average age of the farmer to be 61 years. We think this will all change as pressure from a rising population dramatically transforms the fortunes of farmers.

New agricultural land is required – equivalent to India's in the next 8 years

Available agricultural land is shrinking

Our supply-demand analysis of land paints an alarming picture (Fig 1). By 2020, when we expect the world's population to reach 8 billion, an additional 218m ha of agricultural land will be required. (This projection is based on our conservative assumption of 0% growth in per-capita consumption and 1% pa improvement in production yield.) To put this figure into perspective, in the next 8 years we have to find new agricultural land that is larger than the farms in India. We estimate that Africa and South America could supply some 600m ha of potential new agricultural land each but this would come at a huge environmental cost. Moreover, much of this land is landlocked and prices need to rise significantly to justify the large-scale investment.

Fig 1: Potential new agriculture land required to support a growing population



Source: UN Food and Agriculture Organisation (FAO), Standard Chartered Research estimates

Our equity picks – palm oil & food producers, fertiliser companies, agri equipment producers and agri traders

How to position for the rising population pressure

Soft commodities such as palm oil, corn, rice and sugar will likely be the biggest beneficiaries, followed by copper and gold in the hard commodities space. From an equities perspective, we recommend upstream fertiliser companies, agriculture/forestry equipment manufacturers, palm oil and rubber producers, and agri traders, copper and gold miners as a way to play the 'population pressure' theme, and have created a basket of 20 of these stocks (see Fig 14).

Population pressure

Every week, 2 million babies are born. This is equivalent to more than one New Zealand being added every fortnight, the entire United Arab Emirates every month and a Japan each year. Meanwhile, life expectancy is rising due to medical advances and diet improvements. As China enters a phase of slower economic growth, population is likely to become one of the most important drivers for commodity prices over the next decade. We project Africa will contribute the largest increase in population and could overtake both China and India as the most populous region on the planet in the next 10 years. This detailed report suggests that the world's population will reach 7.2 billion by the end of this year and 8 billion by 2020. At the current growth rate, the population could reach 9 billion by 2030. A child born today would celebrate his/her 18th birthday in a very crowded world while the gap between the haves and the have-nots should widen. Inflation is likely to be a major issue for emerging and developed economies. We are by no means population experts, but even assuming a steady slowdown in population growth rates for China, India and Africa, the numbers are still staggering.

Africa to become the world's most populous region in 10 years

Figure 2 illustrates our projection that the largest population growth will come from Africa. Its population today is fast approaching 1.1 billion. Of the 56 countries on the continent, 26 have not conducted a population census in the past 8 years. We acknowledge that there have been many complex population studies done before; we have chosen a simple methodology for our analysis. We analysed all 196 countries and applied an adjusted growth forecast since 1961 to reflect recent improvements in life expectancy and birth rates. As a country grows in economic status and its middle class emerges, birth rates typically fall. That said, the law of large numbers also applies. Our study is not focused on demographics. In reality, a poor man eats more rice or a millet meal than a rich man. We think that most forecasts of Africa's population are conservative and we expect it to reach over 1.4 billion by 2020. Africa's population is young, relatively free of consumer debt and has a fast-growing middle class. We think it is a force to be reckoned with. With Africa's demographic shift likely to result in a larger working-age population as a percentage of its total population, Standard Chartered's African research has identified Africa's favourable demographic trends as a key driver for future consumption trends – and overall economic growth in the continent.

Fig 2: World's rising population – Africa might take everyone by surprise

Country	1961	%	Country	2012E	%	Country	2020E	%	Country	2030E	%	Country	2040E	%
China	667	22%	China	1,350	19%	China	1,440	18%	Africa	1,815	20%	Africa region	2,166	22%
India	457	15%	India	1,250	17%	Africa	1,424	18%	India	1,604	18%	India	1,731	18%
Africa	294	9%	Africa region	1,100	16%	India	1,408	18%	China	1,537	17%	China	1,534	16%
US	189	6%	US	325	4%	USA	347	4%	US	370	4%	USA	388	4%
Russia	121	4%	Indonesia	250	3%	Indonesia	273	3%	Indonesia	309	3%	Indonesia	338	3%
Indonesia	94	3%	Brazil	210	3%	Pakistan	234	3%	Pakistan	285	3%	Pakistan	334	3%
Japan	93	3%	Pakistan	200	3%	Brazil	223	3%	Brazil	233	3%	Brazil	318	3%
Brazil	75	2%	Bangladesh	160	2%	Bangladesh	180	2%	Bangladesh	212	2%	Bangladesh	238	2%
Germany	73	2%	Russia	143	2%	Russia	141	2%	Philippines	141	2%	Philippines	165	2%
UK	53	2%	Japan	127	2%	Mexico	128	2%	Russia	137	2%	Mexico	142	1%
Other	977	32%	Other	2,049	28%	Other	2,202	27%	Other	2,352	26%	Other	2,652	26%
World	**3,094**	**100%**	**World**	**7,164**	**100%**	**World**	**8,000**	**100%**	**World**	**8,995**	**100%**	**World**	**10,006**	**100%**

Source: UN, Standard Chartered Research estimates

At its current growth rate of 2.3% pa, Africa's population should overtake India's by 2020 and possibly China's two years later. Africa consumes more beef as a percentage of its population than India. Per-capita consumption of meat in 13 African countries is already higher than the global average. India's population did not have the same impact on beef markets due to religious beliefs. Africa has abundant land for agriculture production. We estimate some 600m hectares can be utilised for agricultural purposes without the use of irrigation. Much of this is currently covered by forests. So far, investment in Africa's agriculture has been slow as agricultural prices have been too low to justify it. African land ownership is also a sensitive issue and the prospect of Asian or Middle Eastern countries doing deals with African leaders to tie up large tracts of land will not be easy to achieve.

Fig 3: Growth of the three most populous regions – slowing but from a large base

	1951-60	1961-70	1971-80	1981-90	1991-20	2001-10	2011-20E	2021E-30E	2031E-40E
China	1.80%	2.16%	1.90%	1.54%	1.03%	0.55%	0.50%	0.50%	0.00%
India	1.88%	2.15%	2.37%	2.24%	1.89%	1.51%	1.50%	1.38%	1.20%
Africa	2.23%	2.53%	2.75%	2.78%	2.47%	2.34%	2.30%	2.10%	1.85%

Source: UN statistics, Standard Chartered Research estimates

Figure 3 shows the population growth rates since 1951 for China, India and Africa. Africa's nearly 5 times faster than China's and nearly double India's. In the 1960s, China's population grew at 2.16% pa, but this has declined to just 0.50% today given the success of the country's one-child policy. Similarly, India's population growth rate has shrunk from 2.15% to 1.50%. Africa bucks the shrinking trend and is growing at 2.30%, only 23bp less than 5 decades ago. Our forecasts assume that as Africa's current middle-class of 320 million swells, the rate of growth will gradually fall to 2.10% over 2021E–30E and 1.85% by 2031–40E. This is still a healthy rate of growth.

Albeit from a low base, African countries are some of the fastest-growing economies in the world

Figure 2 above shows that the term "BRICS" is essentially irrelevant from the population perspective. It is obvious with India (I) and China (C), but South Africa (S) accounts for only 4% of Africa's total population while Brazil and Russia make up only 3% and 2.5% respectively of the global population. Africa could be the hub of most of the action over the next 20 years. Last year, Ghana reported real GDP growth of around 14.4%, fuelled by oil, to become one of the world's fastest-growing economies. In 2012, Sierra Leone's real GDP growth is conservatively expected to reach 30% YoY, in our view, driven by iron ore, easily topping global growth rankings, albeit from a low base. For the next decade, we expect one of Africa's 56 countries to top the global growth rankings every year, although for most this will be from a low base. With improved quality of life, we expect Africa to follow the same trajectory of life expectancy and lower infant mortality as the global norms. Figures 4 and 5 illustrate how Africa is quickly catching up.

Africa has a relatively young population, with some 55% under 24 years old (Fig 6). This percentage is higher than in India (50%) and significantly higher than in China (36%).

Fig 4: Life expectancy to rise globally

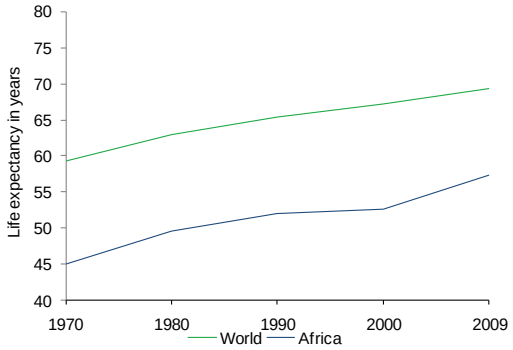
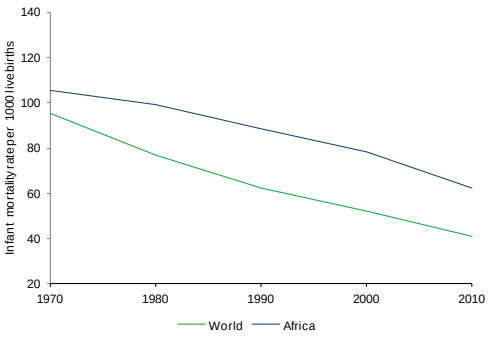
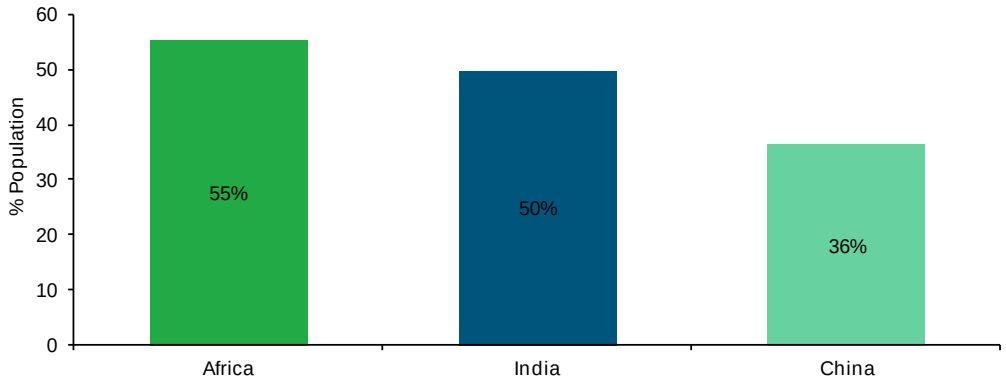


Fig 5: Global reduction in infant mortality



Source: World Bank, UN data, Standard Chartered Research

Fig 6: Percentage of the population below 24 years of age, as of 2011



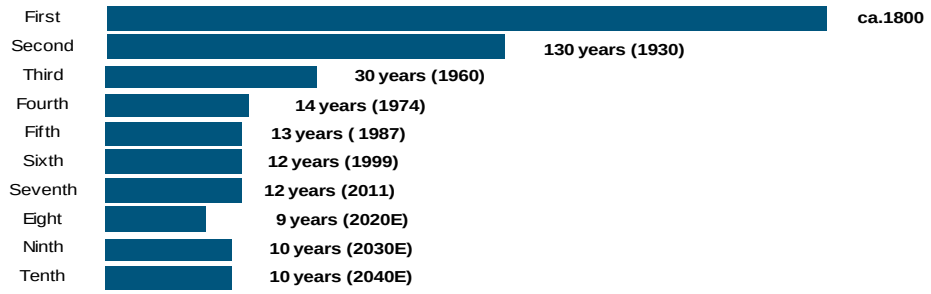
Source: UN data, Standard Chartered Research estimates

World population could reach 8 billion by 2020

Figure 7 below illustrates how quickly the world's population has grown. It took nearly 130 years for the world to grow from 1 billion to 2 billion inhabitants. It now takes about 10 years to add 1 billion people. The one criticism we may receive of this report is that our population forecast for China could be too high. Our assumption that China will grow from 1.35 billion to 1.44 billion people by 2020 and then peak at 1.537 billion by 2030 goes against the projections of some expert China demographers. Of note, Wang Feng, who wrote *The Demographic Factor in China's Transition*, November 2004, and subsequent publications, argues that China is now a "post transitional" society where fertility has declined to below replacement level and within the next few decades, China's population will actually start to shrink. China's adherence or departure from its one-child policy will ultimately be the swing factor, but for our study, if our projection of China's population is high by 100 million, it doesn't really change our main conclusion – that the world is running out of land and prices of soft commodities, gold and copper are likely to rise significantly higher from hereon.

Figure 7 also illustrates that purely based on official UN statistics, it took some 12 years for the world to reach 7 billion inhabitants. Although population growth is slowing, the law of large numbers implies that ~1 billion people are now being added every decade.

Fig 7: Rising population – 1 billion people added every 10 years



Source: The Global Education Programme, The UN, Standard Chartered Research estimates

Figure 8 ranks the performance of the key commodities we analyse in this report. The big beneficiaries from China's urbanisation of the past decade are iron ore, silver and coking coal. Gold and copper prices have also risen by some 400% as central banks globally have turned on their printing machines in the past few years. Soft commodities during the 'China era' underperformed relative to their industrial cousins. Beef and chicken prices have significantly lagged other commodities despite the substantial rise in the price of soy and corn feedstock. Over the past 10 years, beef and chicken farmers have seen their net margins eroded considerably. As Africa takes over as the growth engine for commodities, the make-up of the 5 best-performing commodities should shift towards soft commodities. Urbanisation will be a key theme for Africa, as it has been in China, but Africa should arguably be more self sufficient, especially in commodities such as iron ore and coal where the continent would be less reliant on imports.

Fig 8: Commodity price gains over 2002-12E – how soft commodities missed the boom

	% gain		% gain
Iron ore	700	Soybean	188
Silver	668	Rice	182
Coking coal	414	Palm oil	135
Copper	406	Wheat	125
Gold	398	Beef	89
Sugar	324	Chicken	45
Corn	208		

Source: Indexmundi, Standard Chartered Research estimates

Producer power is likely to rise and pressure from the growing global population comes at time when yield per hectare on existing farms could be nearing a limit. It is also when China is likely to become increasingly reliant on food imports. Soybean has long been a substantial import for China, and now corn seems to be heading the same way. For the past 30 years, cheap food has suited nearly everyone: governments have been able to keep to their inflation targets; powerful supermarket chains have been able sell their produce for multiple mark-ups to what they pay farmers; consumers have been able to use cash they would have used for food to buy houses, cars and go on holidays. The only group this system for whom this system has not been good is farmers. Until the brief price spikes in 2007, farmers have been squeezed every year since the early 1980s by rising costs but stagnant or falling prices. Most governments have kept food prices low in order to win the urban vote. All of the key ingredients that make up our daily diet of wheat, corn, rice and meat took 28 years to move above their 1980 highs. Little wonder then that the average age of a farmer is 61 years.

Fig 9: Current average age of farmers in 6 key countries

	Age (years)
Australia	70
US	67
Argentina	45
Brazil	45
Japan	66
China	65
Average age	**61**

Source: Standard Chartered Research estimates

By the time the population reaches 8 billion in 2020, many farmers will be retiring. Most children do not want to take over the family paddy field or the sheep farm. Instead, they leave for the cities, advising their fathers that it is time for retirement and to sell the paddy field to a property developer. The result is fragmented land ownership, much of which is not scalable.

Fig 10: So what does it all mean to the growing pressure on land?

	2011	2020E	2030E	2040E
Population (m)	**7,000**	**8,000**	**9,000**	**10,000**
Existing agriculture land supply (m ha)	4,189	4,054	3,934	3,829
Scenario 1: 0% growth in per-capita consumption (m ha)				
Land required	0	218	437	643
Increase in green house gas emissions per year* (CO_2 in tonnes)		1,349	2,806	4,129
Land left to cultivate; in Africa (600m ha), in South America (600m ha)	1,200	982	763	557
Scenario 2 (worrying): Historical growth rate in per-capita consumption				
Land required	0	373	852	1,358
Increase in greenhouse gas emissions per year* (CO_2 in tonnes)		2,395	5,472	8,721
Land left to cultivate; in Africa (600m ha), in South America (600m ha)	1,200	827	348	-158

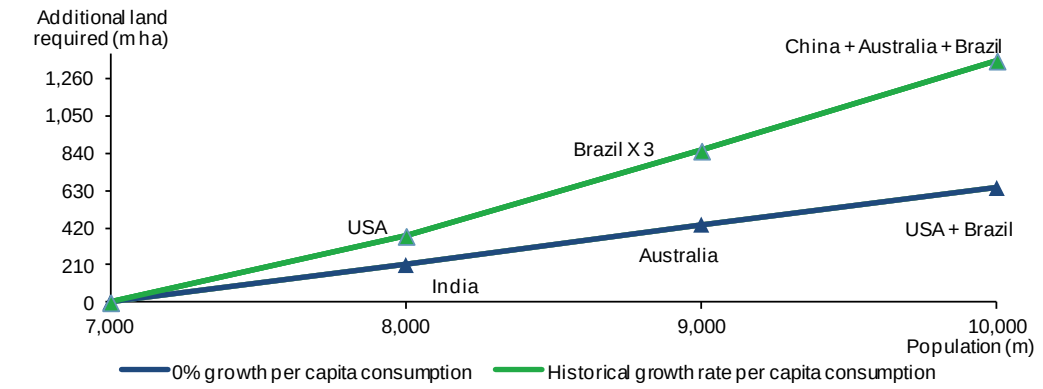
* CO_2 emissions that would not be captured as a result of cutting down mature trees (refer to the section on land demand and supply for more details)
Source: FAO, Standard Chartered Research estimates

Scenario 2 assumes that the world's food consumption will continue at the same rate as the past 40 years; this is worrying but probably unlikely. In reality, if food prices rise as dramatically as we expect, then the rate of food wastage – so common today – should slow. The other feature to consider is that the world is self-correcting. While our analysis is binary, in reality, if the population grows as we expect, the inflationary impact would affect affordability and fertility rates. If Africa's population grows as we project, this is good for its peasant farmers who will profit from higher prices; but may be negative for African consumers, and would be even more negative for some Asian countries who may be relying on Africa to be their future food basket. This is why we think Scenario 2 is unlikely, but it does help to show that even on the most optimistic yield assumptions for crops the world could be running out of land.

Even under the most optimistic scenario, the world needs another India or Russia by 2020 to bridge the supply-demand gap

Unlike iron ore or natural gas where the industry can raise hundreds of billions of dollars to expand capacity, the global farming community has limited avenues to raise money to grow capacity. While equity markets have seen the occasional Ukrainian IPO promising to buy large tracts of farming land, this does not really solve the problem – the world needs at least 218 million new hectares in the next 8 years, assuming 0% consumption growth. This is equivalent to half of America's current farming land. To put things in perspective, China's total agricultural land area is only 308m ha. The storm clouds are gathering in the shape of rapid population growth, slowing yield growth, ageing farmers, strong middle men, growing Chinese food imports, increasing land reclamation and an African continent that has not yet seen a green revolution, which also seems a long way away from large-scale farm investments.

Fig 11: Potential new agriculture land required to support the growing population

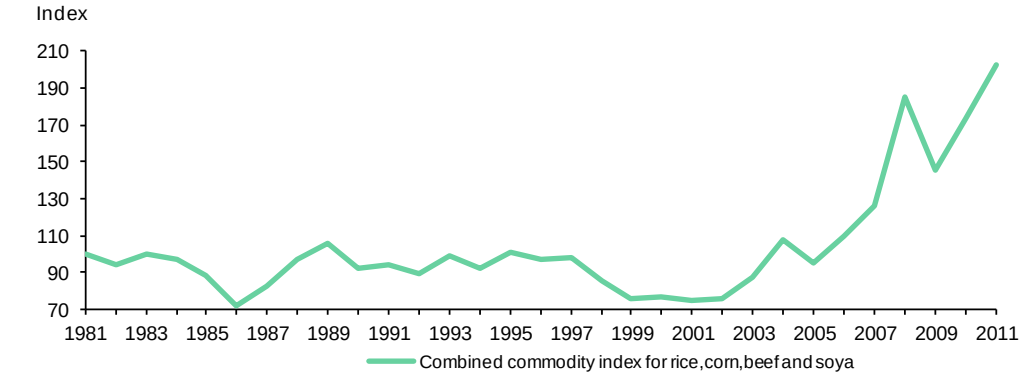


Source: FAO, Standard Chartered Research estimates

Why does an onion grower in Tasmania, Australia receive only A¢20 per kilo while the supermarkets can sell them for A$4? Surprisingly perhaps, that same farmer received A¢40 for them in 1980. Why does a Cerrado coffee grower in Brazil receive only c.2% of the price that a

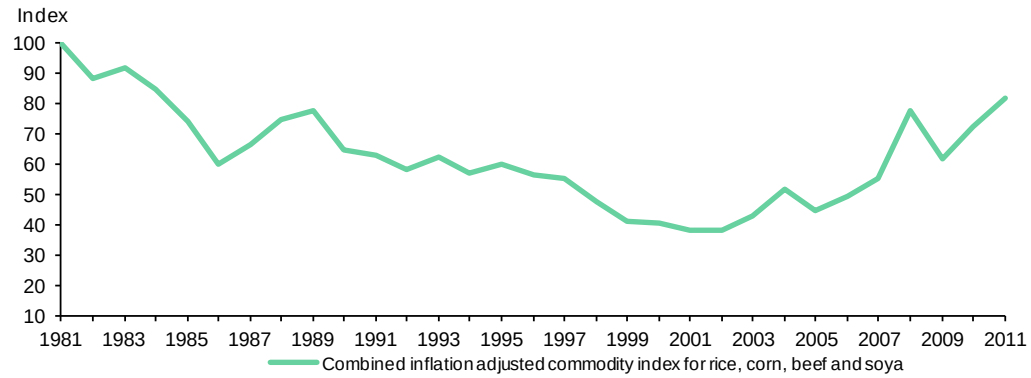
coffee shop in IFC2 in Hong Kong charges its customers for a cappuccino? The bull market everyone talks about in soft commodities has really been a bull one for only a few select commodities such as palm oil, corn, soya and perhaps wheat. The rest have been laggards, and the pressure from a rising population could change all of that. Although Figure 12 shows rising prices since 2006/7, the reality is that most of these gains have been offset by higher costs.

Fig 12: Index of key agricultural commodity prices (nominal)



Source: Indexmundi, Standard Chartered Research estimates

Fig 13: Index of key agricultural commodity prices adjusted for inflation



Source: Indexmundi. www.Inflationdata,com, Standard Chartered Research estimates

The chart above illustrates that agricultural prices have been depressed for nearly 30 years adjusted for inflation. In fact it has taken 27 years for the price of rice to reach its 1981 high; corn farmers had to wait 13 years before it rallied in 2008 above its previous high. Beef prices regained their 1991 highs only in 2005, and soybean prices had to wait 13 years to reach their 1984 high in 1997 but it then took until 2009 for a new high. To survive, farmers have relied on yield improvements, land sales and subsidies if they are based in Europe and the US.

When will corn prices sell for US$15 per bushel (currently US$7.18)? When will a beef cow sell for US$2,000 (currently US$800)? And when will soybean farmers receive over US$30 per bushel? We think these are the kind of prices that consumers may need to adapt to as we approach a global population projection of 8 billion. These are the prices required to justify large-scale investment in new frontiers such as Africa and Brazil, where many farmers are at least 1000km from a port. Governments and corporates would also be more likely to address infrastructure and land tenure issues when there are higher profits at stake.

Gold is another beneficiary. Today, the average person buys 0.5 grams of gold pa. We assume this rate slows as the population increases, but even then, we need to find another 4 Newmonts (one of the world's leading gold producers) as the world's population approaches 8 billion. This

is at a time when China has been importing huge volumes of gold since November 2011. At the current rate of gold imports from January to May 2012, China will consume some 35% of the world's gold this year. This is up from just 17% in 2011. Our assumption that consumption rates of gold will drop could prove too conservative.

Copper is the same. As the global population reaches 8 billion people, the industry would need to build another two new Escondidas (the world's largest copper mine). Our numbers also assume that the intensity of copper drops, as Africa's need for copper for urbanisation is not going to be as great as China's. Many of the copper projects that the junior miners have been wanting to develop have been put on hold again due to the current financial crisis that has engulfed governments and debt/equity markets. Despite Africa's urbanisation rate already being at a healthy rate, it is not reflected in commodity prices.

The losers in our view are iron ore and coal. Africa is abundant in both, and we are concerned that the Australian producers are pushing too hard on capacity expansions, in our view.

Positioning for pressures from a rising population

Equity markets are at a crossroads with China. Just when everyone has seemingly become an expert on its five-year plans, urbanisation rates and demographics, China seems to be entering a more mature rate of fixed asset investment and growth. Today, the average fund manager dismisses the theme of population as the next big driver of commodity prices. Africa has not been visited in the same way as China or India. Its potential is almost certainly not discussed widely, which is why this theme may take time to gain momentum in the markets.

We have chosen 20 stocks and created a basket of those we think will benefit from the population pressure and the explosive growth that is likely to emerge from Africa. Our top picks are in line with our expectation that copper, gold and soft commodities will be big winners as the world approaches 8 billion people by 2020, and they fall under the following sectors.

1) Miners – gold and copper with sizeable production growth and Africa exposure

2) Inputs and machinery for soft commodities (fertilisers and agri equipment)

3) Companies producing soft commodities such as palm, corn, sugar, meat and fish

4) Agri distributors and traders

In the above industries, we have considered companies with stock liquidity, market cap and Africa exposure. For companies in our coverage, we have chosen only those with In-line or Outperform ratings. We have also chosen companies that have African exposure such as Olam (OLAM SP, Outperform, SGD1.86, PT SGD2.70), Wilmar (WIL SP, In-Line, SGD3.6, PT SGD4.45), Agriterra (AGTA LN, Not rated), Sime Darby (SIME MK, In-Line, MYR9.99, PT MYR10.17) and Golden Agri (GGR SP, Outperform, SGD0.72, PT SGD0.87). We also believe that the upstream fertiliser companies, such as Potash Corp (POT US, Not rated) and crop-protection producers such as Syngenta (SYNN VX, Not rated) could be winners of the population pressure. Monsanto (MON US, Not rated) could stand to benefit from increased demand for its seeds and traits that have increased yields or other beneficial properties in the face of ever-increasing demand, while available agricultural land dwindles. Moreover, companies which produce agricultural and forestry equipment, such as John Deere (DE US, Not rated), could stand to benefit from the 'rise of the farmers', as Africa continues to modernise and transition to more advanced farming technology.

Although 'land' appears the biggest winner from this analysis, it is difficult to find many entities outside of listed palm oil and rubber names. Agriterra Plc is one the few African names we could find. Agriterra's operations are centred in Mozambique using a collective farmer scheme. This is the type of name we think will have an exciting future but they are few and far between and lack sufficient liquidity for most institutional investors.

Fig 14: Potential beneficiaries of our 'population pressure' scenario

Company name	Ticker	Curr	Price	Rating	PT	Market cap (US$m)	Description
Agriterra Plc	AGTA LN	GBp	3.52	Not Rated	NA	58	Agricultural company with established beef, cocoa trading, maize processing and palm oil operations in Sierra Leone and Mozambique.
Banro Corp	BAA CN	CAD	3.64	Not Rated	NA	716	Gold miner operating in the DRC, with 4 mines on the Twangiza-Namoya gold belt. Current production is estimated at 120koz of gold from one operating mine, with the other 3 scheduled to come online in the next year or two.
China Bluechem	3983 HK	HKD	4.27	In-Line	6.25	2,539	Develops, produces and sells minerals, fertilisers and chemical products. Annual production capacity of 1.84mm tonnes of urea, 0.5mm tonnes of phosphate fertilisers and 1.6mm tonnes of methanol. Has largest production volume of urea and methanol in China, is a subsidiary of CNOOC.
First Quantum	FM CN	CAD	17.84	Not Rated	NA	8,328	Produces LME grade A copper cathodes, copper in concentrate, nickel, gold and sulphuric acid. Has operations in Zambia, Mauritania and Australia. In 2011, production was 265,576 tonnes of copper, 175,225 ounces of gold
First Resources	FR SP	SGD	1.99	Outperform	2.25	2,479	First Resources is primarily engaged in the production of crude palm oil (CPO) in Indonesia and currently has plantation assets of more than 134,000 hectares. The company operates nine palm oil mills to produce CPO and palm kernel.
Genting Plantations	GENP MK	MYR	9.97	In-Line	9.27	2,375	Operates plantations. Through subsidiaries, it also processes fresh fruit bunches, trades rubber wood, provides palm oil mill management services among other things. Owns 6 oil mills with a total milling capacity of 265 metric tonnes per hour.
Golden Agri	GGR SP	SGD	0.72	Outperform	0.87	6,861	Cultivates, harvests, processes, distributes, and sells crude palm oil and palm kernels. Also refines crude palm oil into cooking oil, margarine and shortening for sale and distribution. Has the world's second-largest palm oil plantation by planted area, producing more than 2.5 million tonnes of palm products annually.
Indofood Agri Resources	IFAR SP	SGD	1.51	Outperform	1.83	1,709	Involved in oil palm seed breeding, oil palm cultivation and milling. Also refines, brands and markets cooking oil, margarine and other palm oil products. Produced 838,000 million tonnes of crude palm oil in 2011.
Ivanhoe Mines	IVN US	USD	8.66	Not Rated	NA	8,668	Majority owner and operator of the Oyu Tolgoi Project in Mongolia, one of the world's largest copper-gold-silver mines. Has gold mining operations in Kazakhstan and Australia, along with a majority share of SouthGobi Resources, the largest coal supplier in Mongolia.
Japfa Comfeed	JPFA IJ	IDR	4,600	Outperform	6,000	1,038	Manufactures animal feed, breeds and processes chickens, and operates aquaculture farms. It sells its products domestically and internationally.
JBS	JBSS BZ	BRL	5.84	Not Rated	NA	8,071	Processes beef and pork, producing both fresh and processed meat products, such as corned beef and beef extract. It is the largest animal protein processor in the world; the world's leading beef and lamb producer, the second-largest poultry producer and third-largest pork producer.
John Deere	DE US	USD	78.16	Not Rated	NA	31,087	Manufactures and distributes a range of agricultural, construction, forestry, commercial and consumer equipment worldwide. Supplies replacement parts for its own products and other manufacturers. 2011 revenue: US$32bn.
KLK	KLK MK	MYR	24.24	In-Line	23.31	8,131	Produces and processes palm products, natural rubber and cocoa on its plantations. Through subsidiaries, KLK also manufactures soaps, esters, latex gloves and oleochemicals.
Monsanto	MON US	USD	82.77	Not Rated	NA	44,112	Produces a wide range of modified seeds for farmers. Also provides genetic material and biotech traits for other seed companies. 2011 sales US$11,822m.
Olam	OLAM SP	SGD	1.86	Outperform	2.70	3,505	International supplier of both raw and processed agricultural commodities. Sources, processes, stores, transports, ships, distributes, trades and markets agricultural products. In 2011, Olam sold 8.5 million tonnes of products.
Potash Corp	POT US	USD	44.44	Not Rated	NA	38,175	The world's largest fertiliser company by capacity, produces potash, phosphate, and nitrogen to agricultural and industrial industries globally, for fertiliser and other purposes. 2011 sales: US$8.7bn.
Sime Darby	SIME MK	MYR	9.99	In-line	10.17	18,844	The company is engaged in plantations, property development, heavy equipment and motor vehicle distribution, and energy and utilities. 2011 sales: S$16bn.
Syngenta	SYNN VX	SFR	321.40	Not Rated	NA	30,499	Produces crop protection products, such as herbicides, insecticides and fungicides, and seeds for field crops, vegetables and flowers. 2011 sales US$13.3bn.
Thai Union Frozen	TUF TB	THB	76.25	Outperform	81.15	2,757	Produces and exports frozen and canned seafood products, as well as canned pet food from production by-products.
Wilmar International	WIL SP	SGD	3.6	In-Line	4.45	18,213	Involved in oil palm cultivation, edible oils refining, oilseeds crushing, consumer pack edible oils processing and merchandising, specialty fats, oleochemicals and biodiesel manufacturing, and grains processing and merchandising. 2011 sales: US$44.7bn.

Priced as on 11 July 2012
Source: Standard Chartered Research

Risk – what if population growth slows?

We are by no means population experts but note that our population estimates are more aggressive than the official UN forecasts. Our base-case scenario estimates that the world will reach 10 billion people by 2040, which is 10 years sooner than the UN's 2050 estimate. We assume China's population growth will slow from the current 0.55% to 0%, India's drops from 1.51% to 1.20% and Africa's falls from 2.34% to 1.85%. We could of course be too optimistic but our report is more focused on illustrating what population growth means to commodity prices and land usage. In this section, we illustrate the difference in estimated commodities demand under our population growth scenario compared with the UN growth scenario in the next three decades. Whether you take UN numbers or our slightly more aggressively numbers, the answer is the same – the world is going to face acute shortages and pricing pressure on both soft commodities and copper and gold.

Fig 15: Implied commodities demand – our population growth scenario vs UN population growth scenario

	Our base-case scenario			UN population growth scenario			Variance		
m tonnes	2020E	2030E	2040E	2020	2030	2040	2020	2030	2040
Pork	120	135	150	115	125	133	5	10	17
Beef	72	81	90	69	75	80	3	6	10
Wheat	760	855	950	727	790	843	33	65	107
Chicken	96	108	120	92	100	106	4	8	14
Rice	744	837	930	712	774	825	32	63	105
Corn	984	1,107	1,230	942	1,023	1,092	42	84	138
Palm oil	55	62	69	53	57	61	2	5	8
Cocoa	4.8	5.4	6.0	4.6	5.0	5.3	0.2	0.4	0.7
Soya	288	324	360	276	300	319	12	24	41
Sugar beet and cane	2,184	2,457	2,730	2,090	2,272	2,423	94	185	307
Iron ore	1,520	1,620	1,700	1,455	1,498	1,509	65	122	191
Oil	4,800	5,310	5,800	4,594	4,909	5,147	206	401	653
Copper	21	23	24	20	21	21	1	2	3
Gold	4,240	4,680	5,100	4,058	4,377	4,526	182	303	574

Source: UN, Standard Chartered Research estimates

Yield improvements required to maintain land supply-demand balance

Yield improvements have been slowing in the past 50 years due to overcropping and depleted fields. The average yield improvement in the past decade has been 1% pa vs 3-5% pa in the previous decades. In our base-case scenario, we assume yields will improve by 1% pa and 0% per-capita consumption growth, which we believe is conservative. Under this scenario, we estimate that the world would need new agricultural land equivalent to that currently under cultivation in India or Russia when the global population reaches 8 billion people. The UN forecasts the world population to reach 8 billion people by 2023. Based on that and assuming a 1% yield improvement and 0% per-capita consumption growth, the world would need to cultivate another 165m ha of land by 2023, which is the equivalent to a farm the size of Argentina's current farming land, to maintain land supply-demand equilibrium.

Fig 16: Land supply/demand – our base-case scenario vs UN population growth

Based on our population forecast (m ha)					Based on the UN population forecast (m ha)				
Population (bn)	Year	Supply	Demand	Land required	Population (bn)	Year	Supply	Demand	Land required
8	2020E	4,054	4,264	(218)	8	2023	4,054	4,219	(165)
9	2030E	3,934	4,371	(437)	9	2036	3,934	4,267	(333)
10	2040E	3,829	4,472	(643)	10	2050	3,829	4,302	(473)

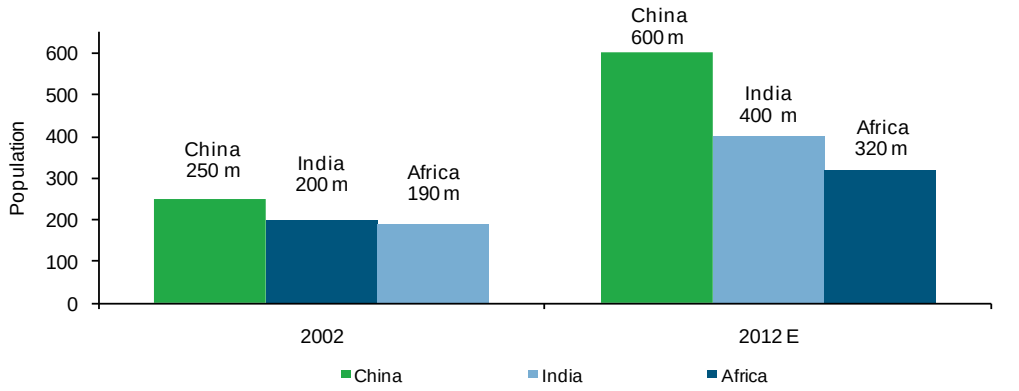
Source: UN, Standard Chartered Research estimates

How Africa is overtaking China and India

- Africa is likely to be the most populous region in the next 10 years
- Africa's middle class has experienced the fastest growth in the last decade
- African countries are some of the fastest-growing economies in the world
- Africa has abundant natural resources; underexplored and underdeveloped

In the early 1990s smart investors would say to us 'one day every man in China will stop riding a bike and want a car and TV'. Despite general scepticism, 10 years later those early bulls were proved right. Most African countries have relatively low levels of consumer debt. In fact most inhabitants are relatively debt free because banks are generally risk averse in terms of lending to small businessmen or families to buy houses. Most items are paid for in cash. At least 90% of the continent's population has no debt and when you have the world's youngest population that is relatively debt free, potentially you have a very powerful consumer emerging. Today Africa has over 320 million middle class citizens who have an annual income of more than US$3,900 per year in purchasing power parity (our assumption of the middle class in China, Africa and India in line with the Africa Development Bank's study (*The Middle of the Pyramid: Dynamics of the Middle Class in Africa* dated 20 April 2011).

Fig 17: The middle-class in China, India and Africa



Source: African Development Bank, Standard Chartered Research estimates

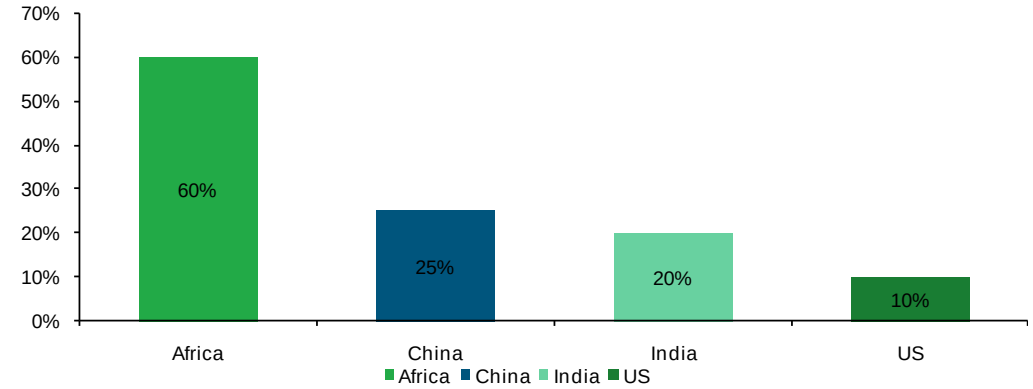
Africa's middle class is rising rapidly and the impact it will have on commodities consumption is significantly underestimated. Standard Chartered's Africa research team has written extensively on this subject. Figure 18 below illustrates the extent of Africa's potential upside. Today, the average African consumes 1/24th the amount of copper of a Chinese person and 1/11th of the iron ore. There is so much more scope for growth in Africa than China, which is near a peak in consumption of industrial commodities be it iron ore, copper or coking coal. Fortunately Africa has abundant supplies of iron ore, which is another reason for our increasingly bearish outlook in the long term.

Fig 18: Commodity consumption per capita in China, India and Africa

kg	China	India	Africa
Copper	8.1	2.1	0.3
Oil (bbl)	2.2	1.2	0.4
Iron ore	684	83	65
Wheat	68	60	43
Rice	77	71	21
Maize	7	5	37
Poultry meat	11	1	6
Milk, whole	24	39	32
Beef	4	2	7

Source: FAO, Standard Chartered Research estimates

Fig 19: Percentage of income spent on food in different regions (2012)



Source: Standard Chartered Research estimates

Despite the pressures associated with oil price weakness, a key challenge for Africa's economic performance in the past, most African economies continue to pull ahead. Only sustained growth over a period of time can bring about a meaningful reduction in poverty and enable structural reform. The population pressure is, to a large extent, driving this, alongside a young and vibrant and largely entrepreneurial mindset. A key question that has long occupied African bulls is whether the growth seen in Africa is cyclical, or represents a significant break from the past. We think it is definitely the latter, as the bull market in industrial commodities in the last decade has contributed to increased wealth in Africa, alongside an improvement in economic management which has resulted in greater stabilisation of African economies, the achievement of single digit inflation, less crowding out of the private sector, and real gains in financial intermediation. In the decade to 2010, Africa saw a greater degree of financial inclusion and a doubling of private sector credit-to-GDP, helping to foster the growth of its middle class. In many of these economies, the high per-capita growth rates expected in the medium term will follow at least a decade of higher per-capita income growth. Despite Africa's stop-start growth in earlier war-torn decades, median incomes are now significantly higher than previous peaks.

Fig 20: Top 20 African countries by GDP growth, 2010

	Countries	GDP growth (%)
1	Ethiopia	10.1
2	Burkina Faso	9.2
3	Zimbabwe	9.0
4	Niger	8.8
5	Congo	8.8
6	Nigeria	7.9
7	Zambia	7.6
8	Rwanda	7.5
9	Democratic Republic of Congo	7.2
10	Mozambique	7.2
11	Botswana	7.2
12	Malawi	7.1
13	Tanzania	7.0
14	Ghana	6.6
15	Seychelles	6.2
16	Gabon	5.7
17	Liberia	5.5
18	Cape Verde	5.4
19	Kenya	5.3
20	Uganda	5.2

Source: World Bank statistics

Africa's swelling middle class is fast approaching the size of India's middle class. Africa is rich in natural resources while India is not; Africa's population is younger than India's; and Africa, as a continent, is significantly less crowded. Africa is also the big winner from Chinese investments, as inflows into major oil, iron ore and copper projects have begun to accelerate after the slow start from 2003-2008. Moreover, large corporates increasingly view Africa as an important future supply source of commodities and have stepped up their investments in the continent. African countries have low debt levels and are rich in natural resources.

We believe the population in Africa, the second-largest continent, may be underestimated. On average, the last census of 26 of the 56 countries in Africa was taken before 2006.

Fig 21: Population growth rates by region in Africa

	1951-60	1961-70	1971-80	1981-90	1991-20	2001-10	2011-20E	2021-30E	2031-40E
Eastern Africa	2.3%	2.7%	2.8%	3.1%	2.7%	2.3%	2.6%	2.6%	1.8%
Middle Africa	1.8%	2.2%	2.7%	2.8%	2.7%	2.3%	2.2%	2.3%	1.6%
Northern Africa	2.2%	2.4%	3.2%	2.0%	1.5%	2.2%	2.1%	2.4%	1.9%
Southern Africa	2.4%	2.6%	3.0%	3.2%	2.4%	1.4%	1.2%	1.1%	0.9%
Western Africa	2.1%	2.4%	2.7%	3.0%	2.5%	2.5%	2.6%	2.6%	1.9%

Source: UN, Standard Chartered Research estimates

Figure 22 below illustrates that the population growth rate is the highest in Sub-Saharan Africa. Even in South Africa, which is considered to be much more developed than rest of Africa, the population growth rate is 2.18% compared with 1.68% for the world and 1.83% for developing Asian countries.

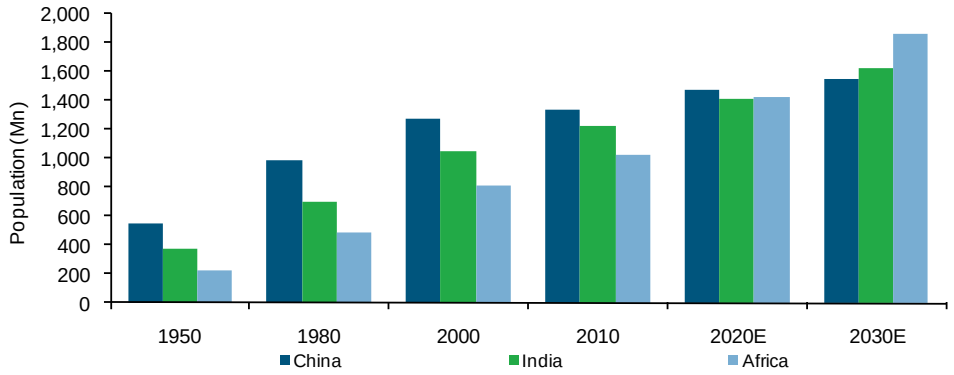
Fig 22: Africa's population growth by country

	1951-60	1961-70	1971-80	1981-90	1991-20	2001-10	2011-20E	2021-30E	2031-40E
Nigeria	2.00%	2.20%	2.80%	2.60%	2.40%	2.50%	2.70%	2.60%	2.30%
Ethiopia	2.00%	2.50%	2.00%	3.20%	3.10%	2.40%	2.50%	2.40%	2.10%
Egypt	2.60%	2.60%	2.30%	2.40%	1.80%	1.80%	2.00%	1.90%	1.60%
DR of Congo	2.30%	2.80%	2.90%	3.00%	3.10%	2.90%	2.80%	2.70%	2.40%
South Africa	2.40%	2.60%	2.60%	2.40%	2.00%	1.10%	0.70%	0.60%	0.30%
Tanzania	2.80%	3.00%	3.20%	3.10%	2.90%	2.80%	3.30%	3.20%	2.90%
Sudan	2.30%	2.50%	3.10%	2.80%	2.60%	2.50%	2.70%	2.60%	2.30%
Kenya	2.90%	3.30%	3.80%	3.70%	2.90%	2.60%	2.90%	2.80%	2.50%
Uganda	2.10%	2.40%	3.20%	3.00%	1.90%	1.50%	3.45%	3.35%	3.05%
Morocco	2.60%	2.80%	2.50%	2.40%	1.50%	1.00%	1.25%	1.15%	0.85%
Ghana	1.70%	2.10%	2.50%	1.10%	3.00%	2.50%	2.45%	2.35%	2.05%
Mozambique	3.10%	2.60%	2.30%	3.10%	2.60%	2.40%	2.45%	2.35%	2.05%
Angola	2.30%	2.50%	2.80%	2.70%	3.10%	3.00%	2.95%	2.85%	2.55%
Niger	1.30%	1.80%	2.20%	2.60%	2.80%	3.00%	3.75%	3.65%	3.35%
Senegal	1.40%	1.60%	0.60%	2.70%	3.80%	1.80%	2.85%	2.75%	2.45%
Zimbabwe	2.00%	2.20%	2.20%	2.80%	3.20%	3.20%	1.89%	1.79%	1.49%
Rwanda	2.30%	3.00%	2.80%	3.00%	2.80%	2.70%	3.15%	3.05%	2.75%
Tunisia	2.20%	2.50%	6.10%	0.30%	1.20%	2.30%	1.25%	1.15%	0.85%
Somalia	3.20%	3.30%	3.40%	3.70%	1.80%	0.10%	2.65%	2.55%	2.45%
Libya	1.40%	1.70%	2.00%	2.30%	0.40%	3.50%	0.62%	0.52%	0.22%
Sierra Leone	2.80%	4.00%	4.40%	3.50%	1.90%	2.00%	2.25%	2.15%	1.85%
Eritrea	1.20%	2.90%	2.40%	3.20%	2.70%	2.30%	3.05%	2.95%	2.65%
Congo	2.30%	2.80%	3.00%	2.90%	2.80%	2.60%	2.18%	2.08%	1.78%
Namibia	2.20%	2.60%	2.60%	3.40%	3.00%	1.90%	1.85%	1.75%	1.45%
Botswana	2.40%	2.80%	3.70%	3.30%	2.40%	1.30%	0.83%	0.73%	0.43%
The Gambia	3.20%	2.10%	3.20%	4.40%	3.00%	2.90%	2.95%	2.85%	2.55%
Swaziland	2.50%	2.50%	3.10%	3.60%	2.10%	1.10%	1.07%	0.97%	0.67%
Africa average	**2.20%**	**2.50%**	**2.80%**	**2.80%**	**2.70%**	**2.30%**	**2.30%**	**2.10%**	**1.85%**

Source: UN Statistics, Standard Chartered Research estimates

Africa's average population growth rate is 2.55%. The death rate has declined from 24.08 in 1960 to 11.95 crude deaths per 1000 in 2011. We believe this will fall more rapidly in the next few years as childhood immunisation steadily increases. We forecast Africa's population to exceed India's by 2020. We forecast that 1.25 billion people will live in Africa by 2015, and 1.4 billion in 2020.

Fig 23: Population over time – Africa likely to leapfrog China and India before 2030



Source: UN, Standard Chartered Research estimates

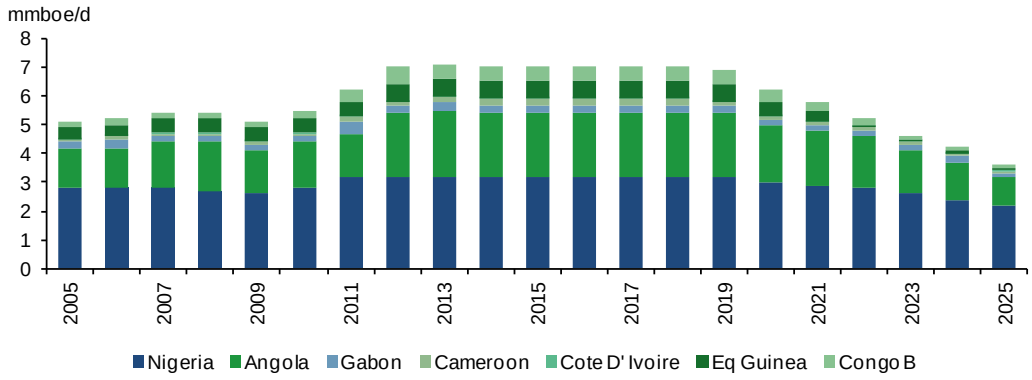
The population density in Africa is lower than the world average, partly because of the Sahara desert, which occupies 25% of the continent's land mass. In agriculture-rich countries such as Cameroon, Zambia and the DRC, the population density is significantly below that of India and eastern China. Vast stretches of land lie ready for cultivation as Africa proportionately has some of the largest areas of uncultivated arable land globally. Price remains the constraint. Until agricultural prices are significantly higher there is limited appetite to invest in large-scale agricultural products.

Population and economic growth hampered by years of civil war

Following years of civil war in Africa since the 1960s in a struggle to gain control of resource-rich countries, the continent has been largely quiet in the last few years. This has attracted investment from Western and developing Asian economies (particularly China) keen to secure commodities supplies. Whilst we are looking at the big picture of Africa as a whole, it is important to remember that Africa is not a homogenous entity. Although there has been an improvement in overall political stability in the continent, different countries have their own economic and political merits. From the DRC to Mali to Ghana to potentially oil rich Somalia, "Africa' covers a broad spectrum.

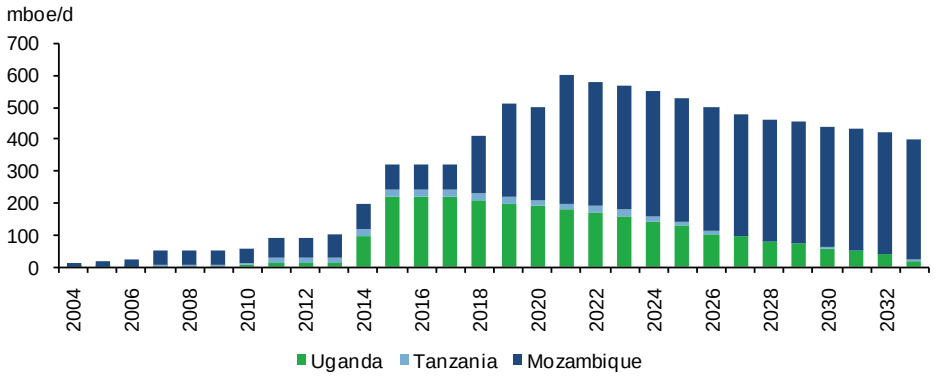
Angola is an excellent example of Africa's oil riches. Although its population is currently only 28 million, we forecast that it will grow to 49 million by 2030 when the world population reaches 9 billion. In recent years economic growth has been astounding and it should be the fastest-growing economy in Sub-Saharan African this year with 8% GDP forecast. Oil output is currently around 1.95 million barrels per day. LNG exports are also due to start in 2012 and will also support export performance. Angola is very sensitive to oil prices and at current production levels a US$1/bbl increase in oil translates into annual export revenues of US$650m or 0.6% of GDP. While the recent price correction is a setback, this is only temporary.

Fig 24: Oil production in West Africa



Source: Wood Mackenzie, EIA, GEM, Standard Chartered Research West Africa Review, April 2012

Fig 25: Gas production in East Africa

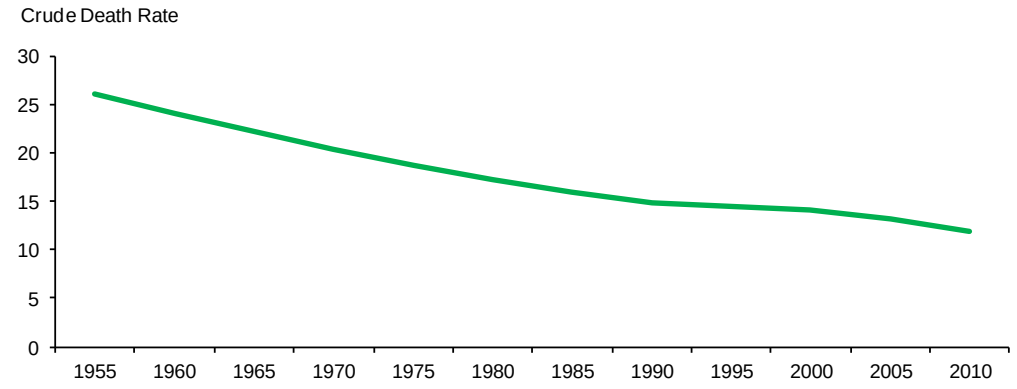


Source: Wood Mackenzie, GEM, Standard Chartered Research

The decline in oil and gas production from 2020 onwards is a result of production being forecast based on current reserves only. These forecasts are likely to be very conservative. East Africa's potential for new gas discoveries is immense.

Rising economic prosperity among Africans means diets are improving. Immunisation schemes in many African countries mean children are now receiving the same kind of protection of those in more developed regions. This is arguably the main reason for declining death rates (see below). However, the going hasn't been smooth across the board. For example, Nigeria has seen a rise in absolute poverty, despite a decade of higher headline growth. Growth has been very unequal in spite of poverty rates coming down on a pan-Africa basis. There have also been problems with immunisation schemes such as the well documented case with the polio vaccine in northern Nigeria.

Fig 26: Crude death rate in Africa over time (deaths per 1,000 of population)



Source: UN data

On the flip side, the fertility rates have been falling much more slowly than in other continents. Fertility rates in most African nations have stayed above 4.0 while Asian countries recorded a decrease of more than 40% from 4.05 to 2.28 in 30 years. In countries such as Niger and Uganda, fertility rates have barely fallen. Many villagers in Africa still believe that having as many children as possible is a sign of prosperity. Better education is key to reducing the fertility rate in Africa, but at the same time lower mortality rates are further increasing the rate of population growth.

Wider availability of clean drinking water, improved sanitation and better sewage systems, and mass immunisation have significantly curtailed or in some cases eliminated infectious and parasitic diseases which caused most deaths in the 20th century. Improved nutrition, better healthcare, and public awareness of simple precautionary measures such as hand washing have contributed to the extension of the average person's life span. AIDS is also no longer the death sentence it was; anti-retroviral treatment seems to be improving life expectancy gradually in some cases.

Fig 27: Expected improvement in life expectancy over the next 40 years

	Improvement in life expectancy (years)
Zimbabwe	18
Central African Republic	18
Guinea-Bissau	15
Burundi	16
Sierra Leone	15
Mali	15
Côte d'Ivoire	15
Zambia	15
Angola	15
Nigeria	15
Swaziland	15
Guinea	15
Chad	15
Somalia	15
Niger	15

Source: UN, Standard Chartered Research estimates

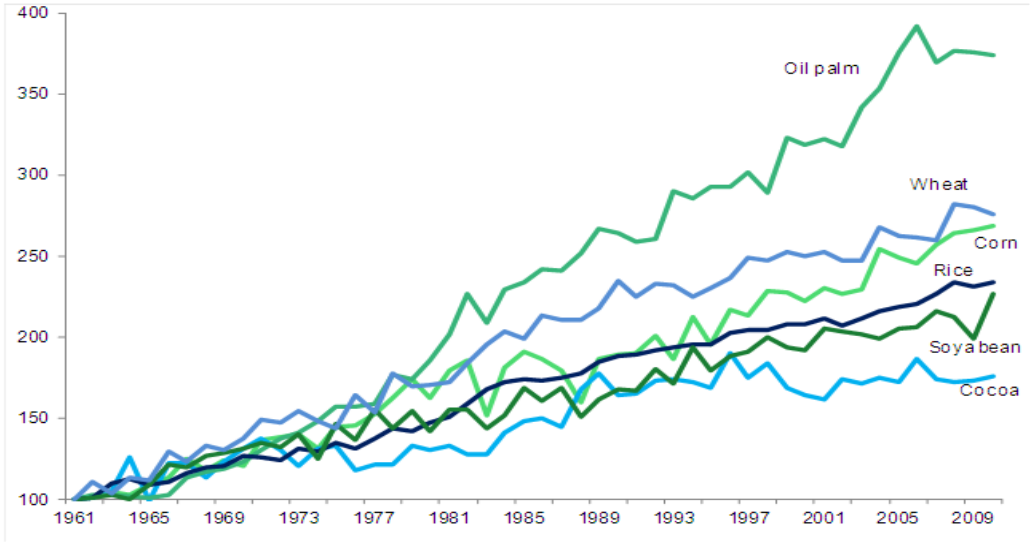
Supply – why yield growth is vital

- Annual yields have improved by 400% in the last 40 years, but this has been decelerating
- Depleted fields, overcropping and extreme weather are impacting yields
- Our supply-demand analysis assumes last decade's yield improvements will be maintained
- Land shortage imminent if we were to feed 8 billion people by 2020

In the past 40 years global farmers have improved their annual yields by as much as 400%, which is why prices declined for long periods for certain crops. The yield growth was solely down to greater use of fertilisers and pesticides, irrigation and larger farm equipment. Today a potato farmer in Scottsdale Tasmania is harvesting up to 70 tonnes of potatoes per hectare compared with just 36 in 1980. Corn growers in Iowa are growing 10 tonnes per hectare, well up from the 5 tonnes per hectare 32 years ago. The biggest improvements have come in China as the heavy use of fertiliser and pesticides have resulted in considerable gains in yield. Chinese rice farmers are yielding 6 tonnes per hectare whereas Thai rice farmers are getting about 3 tonnes. This may in part explain why the farming industry suffered such a decline in fortunes for the last 3 decades, as yields outpaced population growth and oversupply has kept prices low.

In 1980 the average onion grower in Australia was paid 40 cents a kilo for a bag of onions. Today the same grower receives 20 cents a kilo. In Ghana in 1980, cocoa farmers received 118 cents per kg. It took 28 years before prices traded above this level. In reality, until recently prices for most agricultural products were lower than in 1980 even though costs have increased some 5 to 10 times. In short, yield increases and subsidies (in the US or Europe) have superseded the effects of price improvements. However, going forward we question farmers' ability to continue such improvements and there is growing evidence that yields may have peaked because farmers have needed to 'flog' their paddocks to stay in business. It is impossible to measure the extent of over cropping and abuse of soils and pesticides but it is increasingly apparent farms need to rest even to maintain current yields. In Asia, rice farmers are finding it increasingly difficult to cope with pests that are more resistant to pesticides. The only answer for farmers is to let their rice paddies lie fallow for a year. However, the pressure to increase output makes this difficult. Years of low prices also mean farmers do not have the luxury of resting their land.

Fig 28: Index of yield growth from 1961–2010 – the green revolution



Source: FAO, Standard Chartered Research estimates

Our yield assumptions could be too optimistic

Figure 30 below illustrates what the yields of corn, rice, soya and wheat will look like if history is any guide. Assuming yield improvements of 1% pa going forward, corn farmers are expected to increase tonnage from 5.1 tonnes 6.5 tonnes per hectare by 2040. This is in line with the historical yield growth improvements since 1961. Time will tell if yields continue to grow at their historical levels or if possibly they slow due a history over cropping and extensive use of pesticides and herbicides. In reality, the only reason these yields will continue to grow like this is if food prices rise dramatically as farmers chase those windfall profits. Over the last 30 years most farmers have come to believe that bull markets last only one or two seasons and do not recur for another 10 years.

Fig 29: Farmers need to produce even more– gains in agricultural yields

	Annual yield gain			
	50 years	10 years	Our best-case scenario (2012-2040E)	Realistic scenario
Wheat	2%	1%	1%	<1%
Rice	2%	1%	1%	<1%
Corn	2%	2%	2%	<1%
Palm oil	3%	2%	2%	<1%
Cocoa	1%	1%	1%	<1%
Soya	2%	2%	2%	<1%

Source: FAO, Standard Chartered Research estimates

Fig 30: Yield over time – using optimistic assumptions to model land usage

tonnes/ ha	1961	1970	1980	1990	2000	2010	2020E	2030E	2040E
Corn	1.9	2.4	3.2	3.7	4.3	5.1	5.5	6.0	6.5
Rice	1.9	2.4	2.7	3.5	3.9	4.4	4.8	5.2	5.6
Soybeans	1.1	1.5	1.6	1.9	2.2	2.6	2.8	3.1	3.3
Wheat	1.1	1.5	1.9	2.6	2.7	3.0	3.5	3.8	4.1

Source: FAO, Standard Chartered Research estimates

Why we think Africa will be slow to cultivate idle land

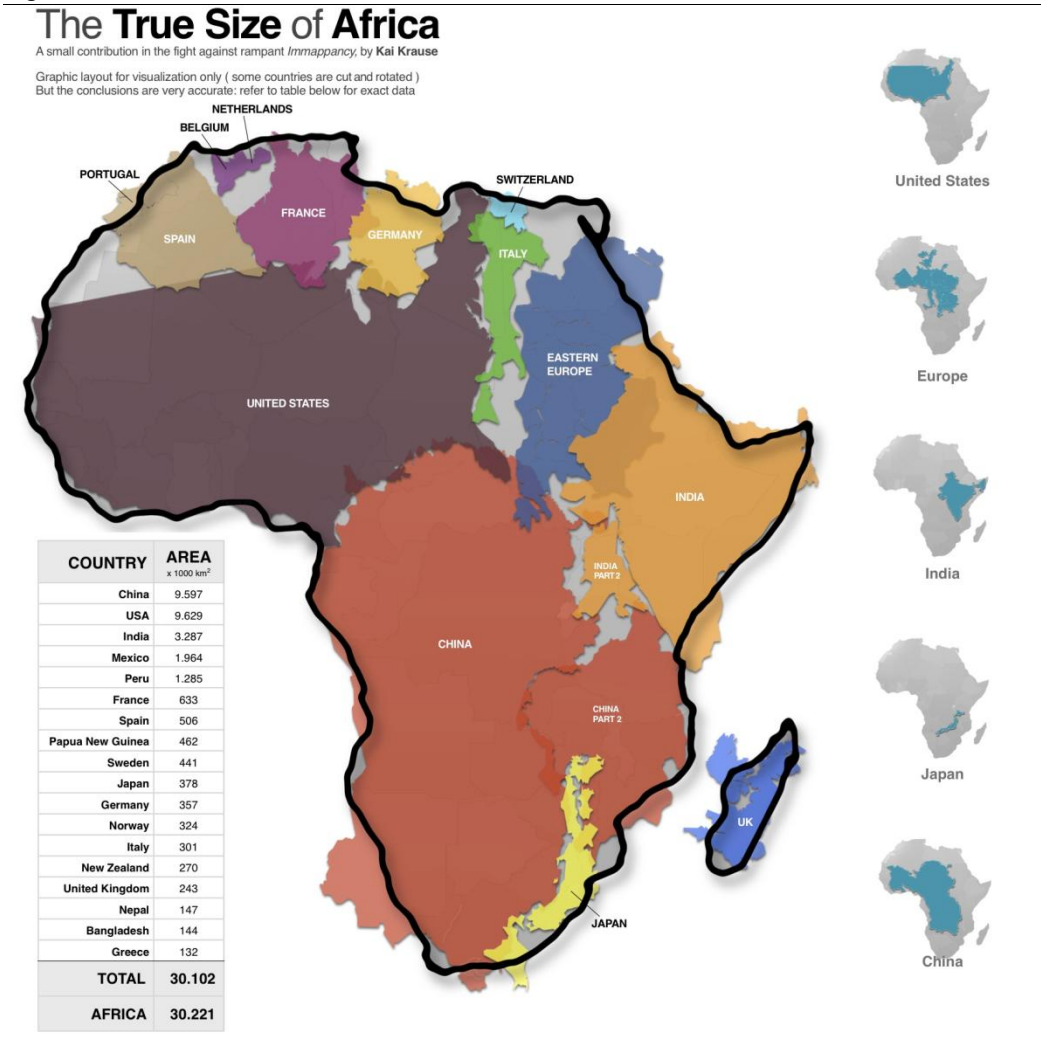
Africa is arguably the only continent that has not abused the application of fertiliser and pest and weed controls. In Tete, Mozambique, the average subsistent farmer with 2 acres yields just 2 tonnes of corn compared with 9 tonnes in Iowa, America. These local farmers have never been able to afford proper seed or fertiliser. In reality they have practised 'organic' farming long before it became fashionable in London or Hong Kong supermarkets. They had no choice because they had no money to adopt western farming practices. This is why we believe Africa is such an exciting prospect for yield improvement: it is the only region that has not been flogged and overcropped. Africa accounts for 24% of global agricultural land but its contribution to agricultural output is much lower. Time will tell if yields will improve dramatically in Africa but again a major improvement in prices is necessary to encourage such investment.

On paper it would seem that Africa can fill the gap to feed the fast-approaching 8 billion world population, but it is not that simple. The average African farmer owns less than 2 acres and the concept of hundreds of small farmers adopting mechanised farming in one area is unlikely to be realised easily. Better seeds and the use of fertiliser is an obvious solution but remember subsistence farmers live for today and not next season. Very often, if a subsistence farmer is a given a bag of fertiliser he/she will sell it rather than plant it. Many small farmers in Africa grow crop to last them until the rainy season, when any unharvested crop will rot due to the lack of proper storage and fumigation. This is when the aid truck rolls up the drive with the next bag of corn to keep famers going until the next season, assuming that the bag has not already been sold at the market. In our opinion, over the last 30 years aid programmes in Africa have contributed to lower yields.

At the same time we continue to hear how some African leaders have pledged large tracts of land to rich Middle East or Asian countries for future agricultural use. We expect significant headwinds for such investments. How do you tell a subsistence farmer in Ethiopia that his 1 acre that is home to his 2 cows, corn crop and 5 children now belongs to an Asian country to grow cabbages for kimchi production? The real future of African agriculture, in our view, lies in providing small farmers with cash buyers for their product who will return each season and require more, and educating them in terms of better farming practices. It is an approach that Agriterra Ltd (AGTA LN, Not rated) has successfully developed in Mozambique. Larger-scale farming works in Zambia, South Sudan or Liberia because these countries are relatively unpopulated; but even then it is complicated and so far western companies have been very slow to make any investments.

Figure 32 below illustrates just how big Africa is. The continent has one of the fastest-growing populations and could quickly become a key driver of global commodities demand.

Fig 31: Africa's land area



COUNTRY	AREA x 1000 km²
China	9.597
USA	9.629
India	3.287
Mexico	1.964
Peru	1.285
France	633
Spain	506
Papua New Guinea	462
Sweden	441
Japan	378
Germany	357
Norway	324
Italy	301
New Zealand	270
United Kingdom	243
Nepal	147
Bangladesh	144
Greece	132
TOTAL	30.102
AFRICA	30.221

Source: flowingdata.com

Demand – a study by commodity

- Per-capita consumption of commodities increasingly driven by urbanisation and greater wealth
- In our model, we assume 0% per-capita consumption growth (kilograms per person)
- Given population growth, demand for commodities will continue to increase
- Land constraints and lower yield improvements are likely to keep markets tight

In this section we illustrate the effect of a rising population on a few important commodities, and the resources required to cultivate or farm them in the future. We have based our analysis on three key assumptions: population growth, consumption per capita and yield growth.

Fig 32: A history of rising commodity consumption

	World population (bn)	Consumption (m tonnes)													
		Pork	Beef	Wheat	Chicken	Rice	Corn	Palm oil	Cocoa	Soya	Iron ore	Sugar cane, beet	Oil	Copper	Gold (tonnes)
1960	3	25	29	222	8	216	194	1	1.2	27	522	608	1,050	4	1,190
1974	4	42	43	359	16	332	327	2	1.6	53	898	883	2,877	7	1,250
1987	5	63	53	505	31	461	446	8	2.1	100	903	1,290	2,948	8	1,660
1999	6	90	59	588	56	611	532	18	3	158	1,020	1,542	3,482	13	2,570
2011	7	106	66	686	86	672	863	49	4.1	262	1,400	1,914	4,351	19	3,780
2020	8	120	72	760	96	744	984	55	4.8	288	1,520	2,184	4,800	21	4,240
2030	9	135	81	855	108	837	1,107	62	5.4	324	1,620	2,457	5,310	23	4,680
2040	10	150	90	950	120	930	1,230	69	6	360	1,700	2,730	5,800	24	5,100

Source: FAO, Standard Chartered Research estimates

Key assumptions

Figures below illustrate the average consumption for both agricultural and industrial commodities. Iron ore and palm oil were two of the fastest-growing commodities in the last 10 years, driven by China and the booming Asian economies.

To create our own demand forecasts, going forward we have used the most conservative estimates for all commodities. We prefer to use lower estimates to illustrate that even with low forecast demand numbers seem to grow significantly as we reach a world population of 8 and 9 billion. We have assumed no growth in per-capita consumption where agriculture commodities are concerned.

Fig 33: Consumption per-capita growth rates pa for agricultural products

	Historical growth (past 50 years)	Historical growth (past 10 years)	Our forecast (2012-2040E)	Realistic forecasts
Pork	3%	2%	0%	2%
Beef	2%	1%	0%	1%
Wheat	3%	2%	0%	2%
Chicken	5%	4%	0%	4%
Rice	2%	1%	0%	1%
Corn	3%	4%	0%	3%
Palm oil	6%	6%	0%	6%
Cocoa	3%	3%	0%	3%
Soya	5%	5%	0%	5%
Sugar	2%	3%	0%	2%

Source: Standard Chartered Research estimates

Fig 34: Consumption per-capita growth rates pa for industrial commodities

	Historical growth (past 50 years)	Historical growth (last 10 years)	Our forecast going forward
Iron ore	3%	9%	-1%
Oil	4%	6%	-0.3%
Copper	3%	2%	-0.5%
Gold	2%	5%	-0.2%

Fig 35: Land required for livestock as it stands today for the average farmer (approx)

	No. of animals per ha
Beef cattle	1
Chickens	2,000
Pigs	22

Source: Standard Chartered Research estimates

Our forecast of land required for livestock is based on the usage assumptions (Figure 35).

In contrast to our assumptions on consumption growth, we assume a very aggressive 1% pa growth in agricultural yields, despite indications that yield growth is tapering off. However, we assume that the yield from livestock remains constant over time, as even more scarce food resources will be needed to increase livestock yield.

Corn – the middle man in commodities

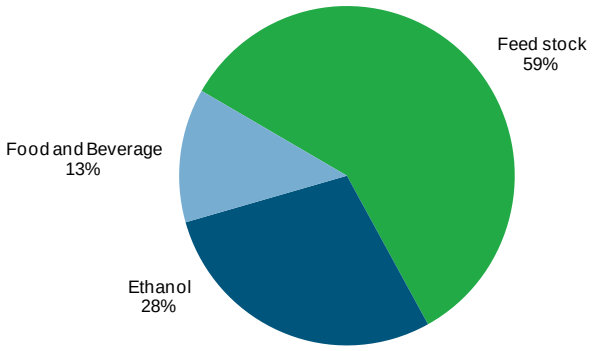
Corn is the second-fastest-growing soft commodity of the past 20 years and arguably the most leveraged to rising population. As the feedstock for both chickens and pigs it is also closely correlated with Asian economic growth. Price pressure could change going forward. We think corn consumption will grow from 863 million tonnes (mt) in 2011 to 984mt in 2020, when the world population reaches 8 billion. Today the average person consumes 123kg of corn per year, a dramatic increase from just 82kg in 1974. This trend is likely to continue as most of the population growth is from Africa and Asia, both big corn consumers. To be conservative, we have assumed 0% per-capita consumption growth (kilograms of corn consumed per person). As with any soft commodity, if prices increase, consumers will invariably become more selective in their choices. Wastage will come down as food prices increase. However, it is difficult to imagine that per-capita consumption levels will fall from current rates given the rising income levels of Africans and Asians. Corn is such an important staple diet of Africans (in the form of millet meal) that our 0% consumption growth rate per person is probably too conservative.

Fig 36: Corn consumption

	World population (bn)	Consumption (m tonnes)	Consumption per person (kg)	Land harvested (m ha)	Productivity per ha (t)
1960	3	194	65	102	1.9
1974	4	327	82	118	2.8
1987	5	446	89	132	3.4
1999	6	532	89	139	3.8
2011	7	863	123	168	5.1
2020E	8	984	123	178	5.5
2030E	9	1,107	123	183	6.0
2040E	10	1,230	123	188	6.5

Source: FAO, Standard Chartered Research estimates

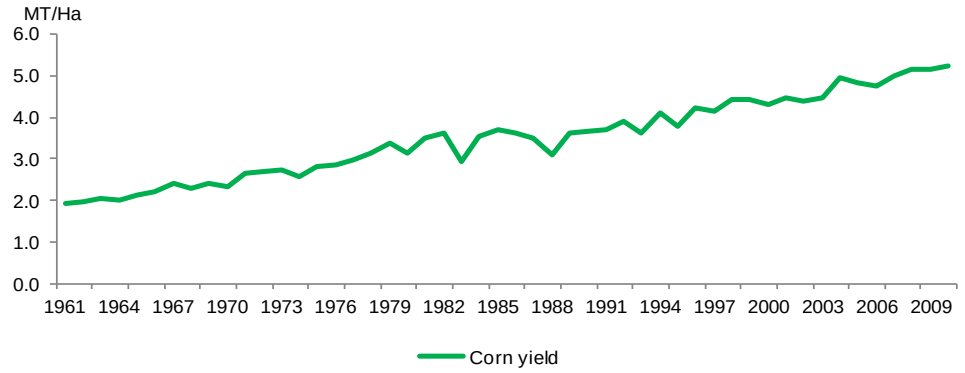
Fig 37: Current global corn consumption by end-use



Source: Standard Chartered Research estimates

Today, the world utilises more than 168m ha of land to grow 863mt of corn. This is an average yield of 5.14 tonnes per hectare. Figure 39 below illustrates that corn yields have improved enormously over the last 50 years but the rate of improvement has tapered off recently. Our model assumes that the world's farmers will become increasingly efficient and reach 5.5 tonnes per hectare by 8 million population by 2020 and 6.0 tonnes per hectare by 9 million by 2030. In reality to create a major step-change in productivity farmers will need to accelerate their use of fertilisers, irrigation and genetically modified seeds. The biggest yield gains are expected to come from Africa where farmers are only currently yielding some 2-3 tonnes per hectare. Farming techniques used in Africa are still largely traditional compared with the US where yields are 9 tonnes per hectare. Therefore major capex spend will be needed to increase yields, which looks prohibitive given current corn prices of US$240-280 per tonne. We think the economic trigger point for major capex spend is closer to US$400 per tonne.

Fig 38: Growth in corn yield over time



Source: FAO, Standard Chartered Research

As the world's population reaches 8 billion and assuming an improved yield of 5.5 tonnes per hectare, farmers will need to plant an extra 10m ha of land by 2020. By the time the population reaches 10 billion we think this figure will grow to 20m ha, which is equivalent to the total farming land of Thailand today.

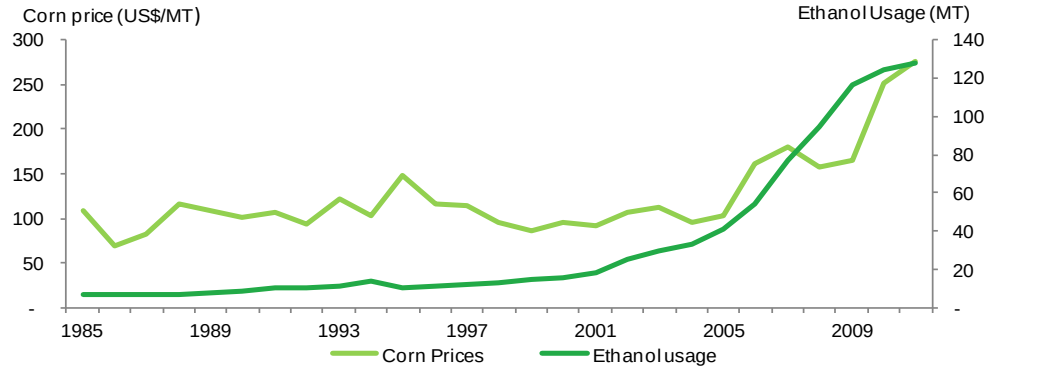
Fig 39: Additional land required for corn cultivation as the population increases

Year	Population (bn)	Consumption (m tonnes)	Productivity per ha (t)	Additional land required for cultivation (m ha)	Cumulative land required for cultivation
2020E	8	984	5.5	10	10
2030E	9	1,107	6.0	5	15
2040E	10	1,230	6.5	5	20

Source: FAO, Standard Chartered Research estimates

The recent trend of increasing demand for ethanol as a renewable energy source is also fuelling demand for corn. It is the main feedstock for producing ethanol in the US. As the figure below illustrates ethanol usage in the US has increased nearly seven-fold since 2001, which coincides very much with the corn price hike over 2004–2011. In fact, US ethanol usage and the corn price have a correlation co-efficient of 0.87 from 1985 to 2011. Interestingly, the recent correction in crude oil prices has not affected corn prices, which have actually rallied due to dry weather in the US.

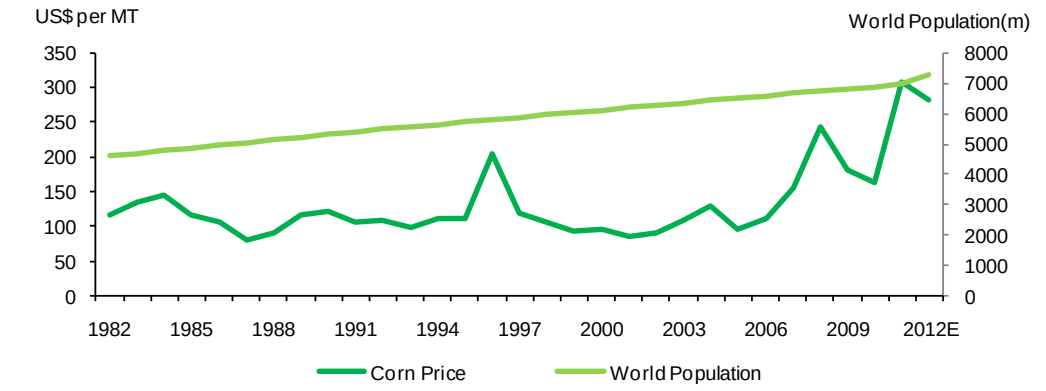
Fig 40: Increasing US ethanol usage and corn price



Source: Standard Chartered Research

While there have been ebbs and flows in its ride to US$270+ per tonne, it is highly unlikely that corn will ever retreat to its pre-2007 prices. It took more than 10 years for corn to exceed its 1994/5 price. This is another example of a commodity that has been in a long-term bear market. However, it has actually been one of the better-performing commodities. If you were in famer in US Mid-west you have been doing ok. In reality, the industry has suffered for so long that there is massive underinvestment.

Fig 41: Population and corn price



Source: Standard Chartered Research estimates

Palm – the fastest-growing edible oil

Palm oil is the most prolific of all vegetable oil crops. It is also a very versatile product. Palm growers claim it can be found in every other supermarket product, it is used as a cooking oil, to make margarine, cereals, sweets, baked items, cookies, chocolates, and non-food items such as soaps, detergents and cosmetics. Palm oil is also used in animal feedstuff and increasingly as a bio fuel. The per-capita consumption of palm oil has more than doubled from 3.4kg/capita in 1999 to 6.9kg/capita by 2011. The cultivation and production of palm oil has kept pace, registering an 80% increase in the harvest area and a 133% increase in production, as in Figure 42.

Fig 42: Palm oil consumption

	World population (bn)	Consumption (m tonnes)	Total consumption per person (kg)	Land harvested (m ha)	Productivity per ha (t)
1960	3	1	0.5	3.6	0.4
1974	4	2	0.5	3.5	0.6
1987	5	8	1.6	5.3	1.5
1999	6	21	3.4	9.4	2.2
2011	7	49	6.9	16.9	2.9
2020E	8	55	6.9	17.6	3.1
2030E	9	62	6.9	18.1	3.4
2040E	10	69	6.9	18.6	3.7

Source: FAO, Standard Chartered Research estimates

Even with flat consumption compared with 6% during the last 50 years, total palm oil consumption should reach 55mt by 2020, when the world population reaches 8 billion. Some 0.7 million additional hectares of land will need to be cultivated to meet this demand, even if yields improve by 1% pa over 2011–2020. While this may seem like a small amount of land, the problem is finding it within 10 degrees of the equator in an area with high rainfall without cutting down rainforests or depriving orangutans of their natural habitat in Asia. Exacerbating the problem is the fact that current plantations are ageing and productivity is declining as a result. Africa could offer the solution. Unfortunately, many of the proposed investments in countries such as Liberia and Cameroon were postponed due to the 2008 global financial crisis (GFC). The other difficulty with palm oil is that takes 4–5 years for the palms to yield a cash crop, which is a risk investor are wary of.

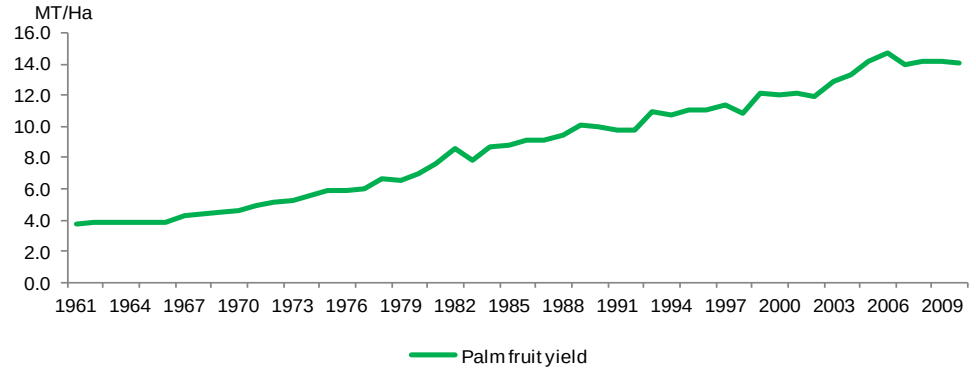
Fig 43: Additional land required for palm cultivation as the population increases

	Population (bn)	Consumption (m tonnes)	Productivity per ha (t)	Additional land required for cultivation (m ha)	Cumulative land required for cultivation
2020E	8	55	3.1	0.7	0.7
2030E	9	62	3.4	0.5	1.2
2040E	10	69	3.7	0.5	1.7

Source: Standard Chartered Research estimates

Of the 17m ha planted currently, close to 1m ha need to be replanted annually, to maintain productivity. It takes about 3–4 years after planting for an oil palm to become productive, after which the next 15 years are the most productive. Therefore, in order to maintain productivity older palms need to be uprooted and new plants grown. We believe the slight tapering off of the yield in the last few years is a result of estates postponing this cycle during the 2008 GFC. Abah Ofon's recent report *'Crude palm oil – A price storm is brewing'*, 30 April 2012, highlighted the severe structural slowdown in palm oil output that is under way. Abah believes the trend will worsen over the coming seasons and is an issue that the market can no longer afford to ignore. The deceleration in palm output is caused largely by the ageing profile of estates in South East Asia, which account for over 90% of global supply. Our conservative estimate is than more than 20% of trees in Malaysia are over 25 years old. In reality this could be more.

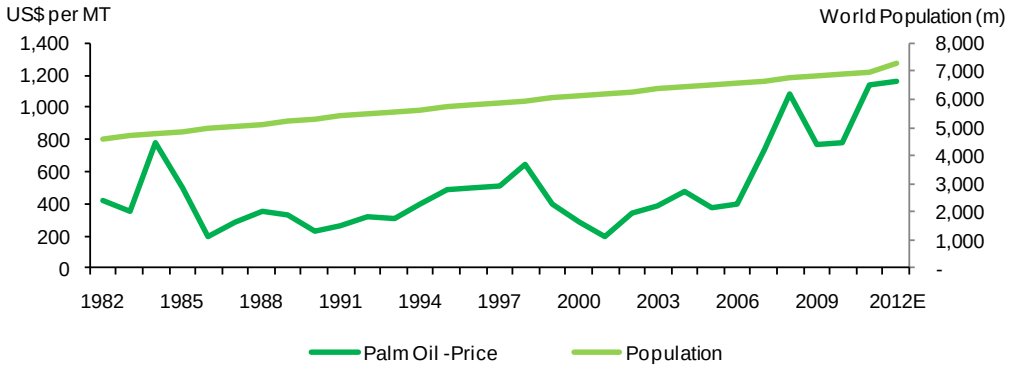
Fig 44: Growth in palm fruit yield over time



Source: FAO, Standard Chartered Research estimates

Palm oil, the most productive of all vegetable oils, yielding 2.9 tonnes of oil per hectare. Therefore, despite the bad press that palm oil has receives for environmental degradation, it is actually the most ecologically friendly of the oil crops because it requires less pesticide and fertiliser due to the smaller acreage required than for other crops. Furthermore, a mature palm oil remains productive for about 15 years compared with crops such as soybean that need to be replanted on an annual basis. Studies have also found that oil palm absorbs more carbon per hectare than other oil crops. Our long-term demand forecast for CPO indicates growing consumption based on rising incomes and population growth.

Fig 45: Population growth and palm oil price



Source: Indexmundi, Standard Chartered Research estimates

In summary, over the near to medium term we see a severe structural slowdown in palm oil output. We believe a price storm is brewing in the CPO industry due to a deceleration in yields, the severity of which will be bullish for the market. With productivity central to the sector, we believe the CPO market is gearing up for a step-change in its cost structure which will push prices higher over the medium term.

Cocoa

Demand for cocoa, which is principally used to make chocolate, has been growing at an average of 3% pa over the last century, with the European and American continents accounting for the bulk of consumption. However, over the past decade emerging markets in Asia, Africa and South America have been growing at a much faster pace than the developed markets.

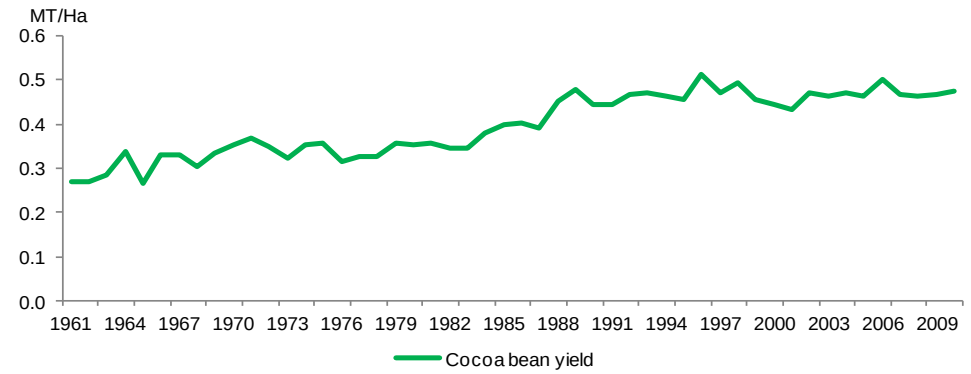
Fig 46: Cocoa consumption

Year	World population (bn)	Consumption (m tonnes)	Total consumption per person (kg)	Land harvested (m ha)	Productivity per ha (t)
1960	3	1.2	0.4	4.4	0.27
1974	4	1.6	0.4	4.4	0.35
1987	5	2.1	0.4	5.3	0.39
1999	6	3.0	0.5	6.5	0.45
2011	7	4.1	0.6	8.7	0.47
2020E	8	4.8	0.6	9.4	0.51
2030E	9	5.4	0.6	9.7	0.56
2040E	10	6.0	0.6	10.0	0.60

Source: FAO, Standard Chartered Research estimates

We estimate land required to meet the increased demand will rise by an additional 0.7m ha by 2020 and a further 0.3m ha by 2030 when the world population reaches 9 billion – it's small. However the fact that this land needs to be close to the equator, 20 degrees north or south, where there is regular and abundant rainfall, with temperatures of c.24–26 Celsius aggravates the problem of where this land will come from. A cocoa tree is most productive from about 5 to 25 years after planting and aging in this industry is the same issue as in palm.

Fig 47: Growth in cocoa yield over time – yield has clearly peaked



Source: FAO, Standard Chartered Research estimates

Fig 48: Additional land required for coca bean cultivation

Year	Population (bn)	Consumption (m tonnes)	Productivity per ha (t)	Additional land required for cultivation (m ha)	Cumulative land required for cultivation (m ha)
2020E	8	4.8	0.51	0.7	0.7
2030E	9	5.4	0.56	0.3	1.0
2040E	10	6.0	0.60	0.3	1.3

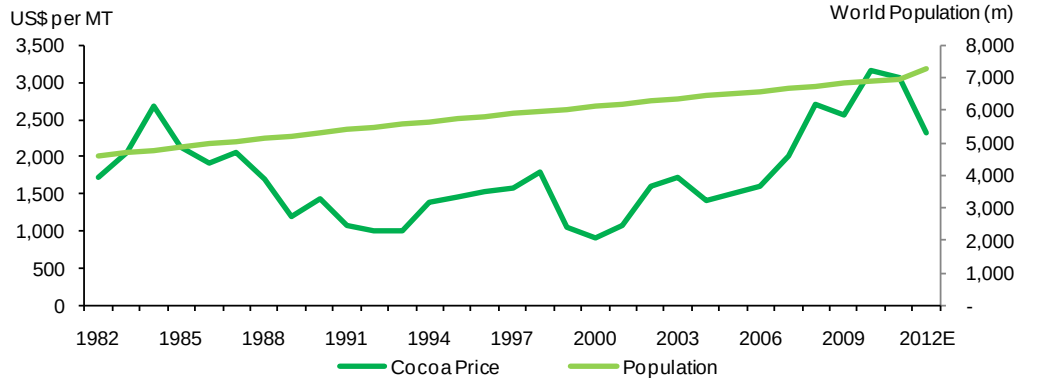
Source: FAO, Standard Chartered Research estimates

Recent cocoa market developments and longer-term outlook

Cocoa prices have dropped significantly from the 32-year high reached in March 2011 at the height of the political crisis in top producer Cote d'Ivoire. However, in our view, the longer-term momentum is to the upside. Possible El Niño weather conditions later this year could exacerbate a potential global cocoa deficit in the 2011/12 season, bringing reduced rainfall to key West African producers. West Africa produces around two-thirds of the world's cocoa, with the top two producers being Cote d'Ivoire and Ghana. According to the International Cocoa Organization (ICCO), El Niño weather could trigger a decline of up to 100 thousand tonnes (kt) in global

production in 2012/13 and will be bullish for cocoa prices. The ICCO currently predicts a deficit of 43kt in 2011/12 (Oct-Sep). This follows a record surplus of 343kt in 2010/11. Global output is forecast at 3.99mt, down 7.4% y/y. Grindings are forecast at 3.99mt, up 1.8% y/y. According to industry regulator Cocobod, Ghana's cocoa production is likely to be around 850kt in the 2011/12 season, well below its target of 950kt, partly due to dry weather. Ghana produced a record of over 1mt of cocoa in the 2010/11 season. Due to the perception of chocolate as a luxury product, cocoa prices tend to highly influenced by economic cycles. We remain fundamentally neutral to mildly bullish cocoa prices due to still-weak economic conditions in Europe and the US, which are the main consumers of cocoa and its derivative products. However, growing demand for cocoa in Asia will be more supportive of cocoa prices, even as traditional demand remains somewhat sluggish in the near term.

Fig 49: Population and the cocoa price



Source: Standard Chartered Research estimates

Beef

Beef consumption per capita has been relatively stable during the last three decades. However, this is likely to change in the next few decades with the economic emergence of beef-consuming Africa. Furthermore, a rising population should naturally increase the demand for beef production. We forecast the cattle that need to be slaughtered per year will increase from 322 million to 351 million by 2020. Beef will become a luxury item for most people, which is why we think demand will flatten.

Fig 50: Beef consumption

	World population (bn)	Consumption (m tonnes)	Total consumption per person (kg)	No. of cows slaughtered per year (m)	Land to breed cows slaughtered each year (m ha)	Yield per cow (kg)
1960	3	29	10	181	181	159
1974	4	43	11	228	228	190
1987	5	53	11	266	266	200
1999	6	59	10	294	294	200
2011	7	66	9	322	322	205
2020E	8	72	9	351	351	205
2030E	9	81	9	395	395	205
2040E	10	90	9	439	439	205

Source: FAO, Standard Chartered Research estimates

More cattle will have to be reared to meet the increased demand for beef. The challenge here is that they need to eat a substantial amount of food: as much as 25kg of dry grass or hay is needed to feed a 500 kg beast each day. This is usually supplemented with corn close to the slaughter date, to increase the marbling effect on the beef. Even if all future beef cattle are farm raised, an additional 29m ha will be needed to rear them by 2020. This is equal to France's current total farmland.

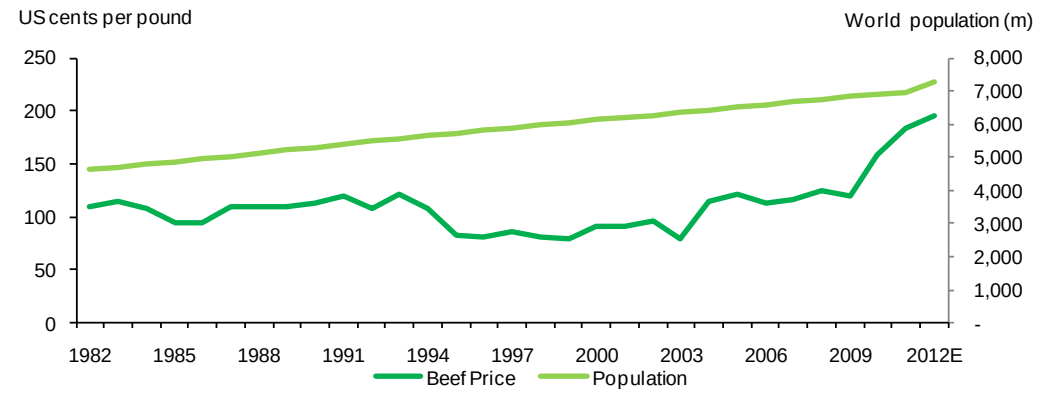
Fig 51: Additional land required for cattle farming

	Population (bn)	Consumption (m tonnes)	Yield per ha (kg)	Additional land required to rear cows (m ha)	Cumulative land required to rear cows (m ha)
2020E	8	72	205	29	29
2030E	9	81	205	44	73
2040E	10	90	205	44	117

Source: Standard Chartered Research estimates

As mentioned above, the beef industry is dependent on corn as a feedstock, and over the last 5 years rising beef prices are positively correlated those of corn. Since 2007 corn prices have risen by c.81% and beef prices by c.68%. Despite this, beef farmers have not reaped the benefits; significant price increases are required to make production growth economic. As an example, on average, an Australian beef farmer makes around A$200-300 profit per beast (after veterinary costs). Our analysis suggests that to make A$100,000 profit you need a 900-acre farm to achieve it. Given that the same farmer can leave his farm and go and work on the mines for a salary of at least A$200,000 it is little wonder that farming is now becoming a hobby for many in Australia which means yields are falling. Therein lies the problem with cattle farming; it is an immensely costly business. A cow eats 25kg of grass to produce only 1kg of beef, and that 1kg of edible beef sells for US$4. Even if you attempt to undertake beef farming in Africa where the cost of labour is significantly lower you cannot overcome the problem of high feed costs and insecure land tenure. The rising cost of corn will be especially tough for US farmers as corn forms a major part of their cattle feed. In reality an average cow needs to sell at double its current price to see a revival of the beef industry. For now, farmers look for anything to grow but cattle.

Fig 52: Population and the beef price



Source: Indexmundi, Standard Chartered Research estimates

Chicken

Chicken is the fastest growing meat sector. Per-capita consumption of chicken has increased 375% over the last 5 decades from 2.5kg in 1960 to 11.95kg by 2011. It is the animal protein that is most leveraged to rising population and growing income levels. Chicken is a meat that is consumed worldwide without cultural taboos. We believe global demand for chicken will reach 96mt by 2020 based on a projected population of 8 billion. We keep consumption per-capita at 1.95kg going forward in a bid to arrive at the most conservative estimates.

Fig 53: Chicken consumption

	World population (bn)	Consumption (m tonnes)	Consumption per person (kg)	No. of chickens slaughtered per year (m)	Land used to farm chickens (m ha)	Yield per chicken (kg)
1960	3	8	3	6,584	3	1.1
1974	4	16	4	13,196	7	1.2
1987	5	31	6	24,430	12	1.3
1999	6	56	9	38,788	19	1.4
2011	7	86	12	55,332	28	1.6
2020E	8	96	12	60,000	30	1.6
2030E	9	108	12	67,500	34	1.6
2040E	10	120	12	75,000	38	1.6

Source: FAO, Standard Chartered Research estimates

As per our estimates, around 28m ha of land is currently utilised to farm chicken, we believe the land requirement will increase by 2m ha by 2020, the total area of farmland in the Netherlands. It's small and somewhat irrelevant to our land analysis, but it illustrates the impact of a growing population.

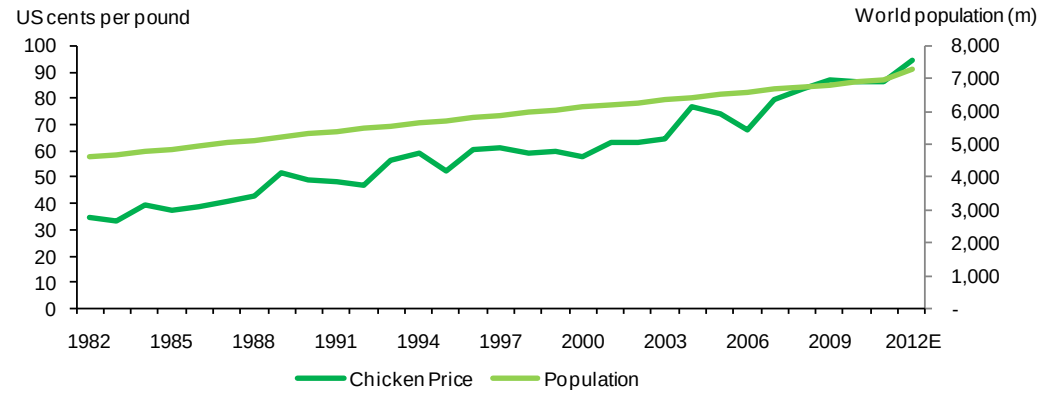
Fig 54: Additional land required to farm chicken as the population increases

	Population (bn)	Chicken consumption (m tonnes)	Yield per ha (kg)	Additional land required to farm chickens m ha	Cumulative land required to rear cows (m ha)
2020E	8	96	3,200	2	2
2030E	9	108	3,200	4	6
2040E	10	120	3,200	4	10

Source: Standard Chartered Research estimates

Unlike most other commodities the price of chicken has risen steadily since the early 1980s. While it is currently the cheapest meat to eat in most regions, its price too will rise. Chicken prices are closely correlated with those of feedstock, such as corn and soybean. Increased demand from a growing population together with rising feedstock prices will consolidate the future upward direction of chicken prices.

Fig 55: Population and chicken price



Source: Indexmundi, Standard Chartered Research estimates

Pork

Pork is the most widely consumed meat in the world, accounting for 35–40% of global meat consumption, although at least 26% of the world's population consumes no pork at all. Pork demand has grown at a compound average rate of 3% per year during the last 50 years. We believe global pork consumption will reach 120mt by 2020.

Fig 56: Pork consumption

Year	World population (bn)	Consumption (m tonnes)	Consumption per person (kg)	No. of pigs slaughtered per year (m)	Land required to farm the pigs slaughtered per year (m ha)	Yield per pig (kg)
1960	3	25	8	376	17	65.9
1974	4	42	11	631	29	67.3
1987	5	63	13	856	39	74.1
1999	6	90	15	1,166	53	77.1
2011	7	106	15	1,344	61	79.1
2020E	8	120	15	1,517	69	79.1
2030E	9	135	15	1,707	78	79.1
2040E	10	150	15	1,896	86	79.1

Source: FAO, Standard Chartered Research estimates

An additional 8m ha or land equal to Malaysia's total current farmland is required by 2020, to meet the increased demand for pork when the world population reaches 8 billion. Again it's a small number but growing pork consumption has a much bigger impact on corn prices and land usage. One day Western governments may let their pig farmers feed their pigs food waste, which is common in many Asian countries and part of their religion that throwing away food is not a good thing spiritually.

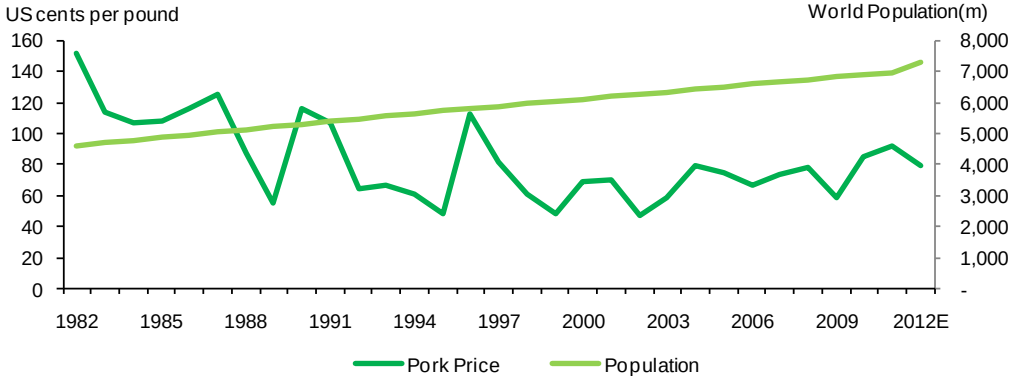
Fig 57: Additional land required to farm pigs as the population increases

Year	Population (bn)	Pork consumption (m tonnes)	Yield per ha (kg)	Additional land required to farm pigs (m ha)	Cumulative land required to rear cows (m ha)
2020E	8	120	1,978	8	8
2030E	9	135	1,978	9	16
2040E	10	150	1,978	9	25

Source: FAO, Standard Chartered Research estimates

Despite China's economic prosperity and its hunger for pork meat, the price of pigs is still way below its high in the early 1980s. Even though the price has trended upwards since 1999, the high cost of corn has offset this, resulting in margin erosion for farmers.

Fig 58: Population and the pork price



Source: Indexmundi, Standard Chartered Research estimates

Rice

According to the International Rice Research Institute in the Philippines (IRRI), rice is said to account for one-fifth of all calories consumed worldwide. In 2011 we are estimated to have consumed 672mt of rice. In reality a poor person eats more rice than a rich person. This is why rice is very much a play on rising population. While Asia is by far the biggest rice consumer, it is the fastest-growing staple in Africa, according to the (IRRI). This is also said to be true for Latin American and Caribbean countries.

Fig 59: Rice consumption

	World population (bn)	Consumption (m tonnes)	Consumption per person (kg)	Land harvested (m ha)	Productivity per ha (t)
1960	3	216	72	115	1.9
1974	4	332	83	137	2.4
1987	5	461	92	141	3.3
1999	6	611	102	157	3.9
2011	7	672	93	154	4.4
2020E	8	744	93	156	4.8
2030E	9	837	93	161	5.2
2040E	10	930	93	165	5.6

Source: FAO, Standard Chartered Research estimates

The 2m ha of land needed by 2020 to meet increased demand does not sound much for the third-most-consumed agricultural product in the world, but this is actually extremely challenging given the requirements. Rain-fed, low-lying land is the best type of terrain for rice cultivation, upland cultivation needs a lot more ground work, and if there is not enough rainfall extensive irrigation is essential to ensure a good crop. To exacerbate the problem, often rice farms are located close to urban centres, and are considered ideal for construction of apartments. Many Asian governments have been compelled to impose laws barring the construction of commercial properties on rice paddy fields. But that still does not solve the problem of finding new rice paddies.

Fig 60: Additional land required for paddy cultivation as the population increases

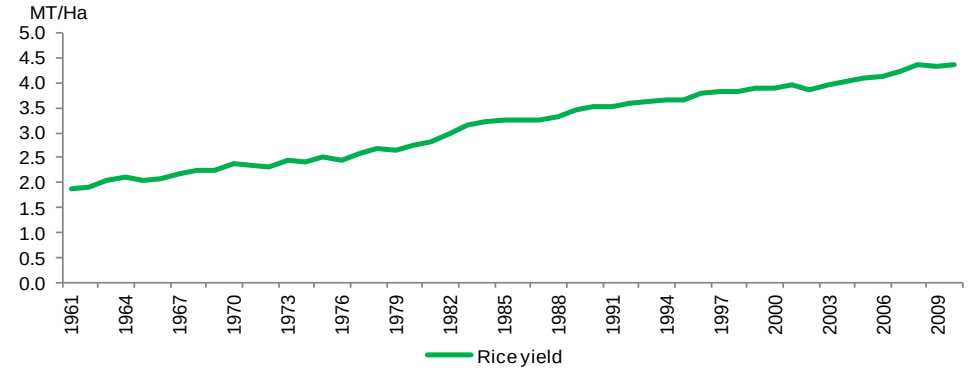
	Population (bn)	Consumption (m tonnes)	Productivity per ha (t)	Additional land required for cultivation (m ha)	Cumulative land required for cultivation
2020E	8	735	4.8	2	2
2030E	9	796	5.2	4	7
2040E	10	853	5.6	4	11

Source: Standard Chartered Research estimates

As illustrated in the figure below, the rice yield curve has flattened over time. This is because depressed prices led to farmers' reluctance to invest in improving the soil in their fields. Rice farmers have been at the receiving end of actions by many governments that fix an artificially low price on rice for political reasons. Thailand is one of the first countries to realise the gravity of this problem, and the government has recently introduced measures to ensure that the farmers receive a decent return. Furthermore, there is evidence that rice paddy fields are becoming more and more resistant to pesticides, requiring the use of stronger chemicals. This is not good for the soil, and fields need to be left fallow for increasingly longer periods in order to recover.

In addition, most rice farms are very small, which makes it very difficult to employ new technologies to increase productivity. According to IRRI statistics, Asia, where about 90% of rice is grown, has more than 200 million rice farms, most of which are smaller than 1 hectare.

Fig 61: Rice yield over time

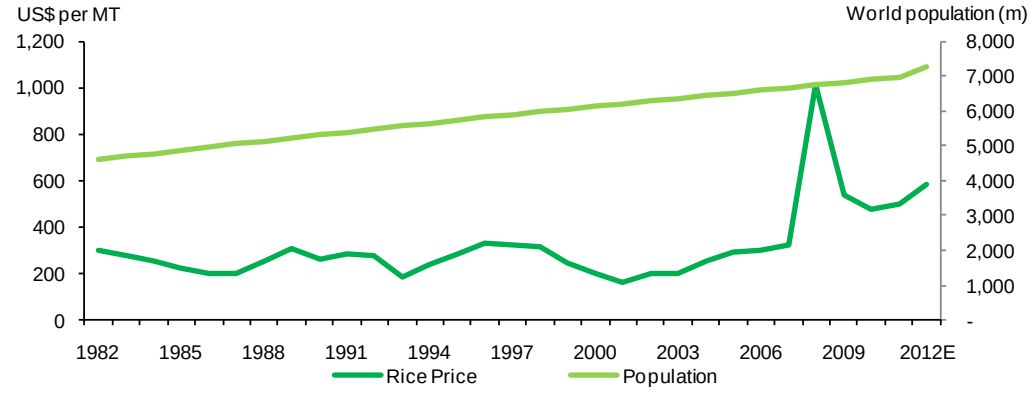


Source: FAO, Standard Chartered Research estimates

Another reason for the flattening in yields is the unchecked use of insecticides. Many rice farmers are uneducated and believe that increased use of insecticides and fertilisers results in a better crop. However, many studies have revealed that this is not the case. Chemicals in insecticides and fertilisers often destroy the complex relationships within paddy field eco systems. In fact, the excessive use of nitrogen fertiliser and insecticides has been known to cause outbreaks of brown plant hopper, which damages rice plants through directly feeding on them and transmitting viruses. We understand that yield loss of up to 60% is common in rice paddies attacked by brown plant hoppers. Chemicals have also been found to increase its fecundity. In an effort to overcome the problem of the brown plant hopper, in 2011 the Thai government restricted the use of insecticides including abamectin and cypermethrin.

Rice is such an important commodity because it is the main source of energy for the majority of the world's poor. Rice is so closely linked with poverty that in 2008, when rice prices tripled, the World Bank estimated that an additional 100 million people were pushed into poverty (IRRI). Given the projected population growth, new demand created from Latin America and Africa, and the flattening rice yields, rice prices are likely to trend higher over the long term.

Fig 62: Population and the rice price, Thailand



Source: Indexmundi, Standard Chartered Research estimates

Wheat

Wheat is the world's most important food crop, ahead of corn and rice. It is part of almost everything we eat from burgers to noodles. However, per-capita consumption of wheat has declined from 101kg per person in 1987 to 95kg in 2011. This is primarily driven by lower production in developed countries where crop reserve programmes to preserve soils have taken away a considerable area from wheat production. In our model, we maintained the per-capita consumption at 2011 levels, given that the rising affluence of Africans and Asians is very likely to cause an increase in their per-capita consumption. As income levels increase people tend to gravitate towards lifestyles propagated by Western culture. There could be numerous reasons for this but what is important is that wheat is a staple in many western-based food, such as bread and cereals.

Fig 63: Wheat consumption

	World population (bn)	Consumption (m tonnes)	Consumption per person (kg)	Land harvested ('000 ha)	Productivity per ha (t)
1960	3	222	74	204	1.1
1974	4	359	90	222	1.6
1987	5	505	101	221	2.3
1999	6	588	98	213	2.8
2011	7	686	95	217	3.2
2020E	8	760	95	219	3.5
2030E	9	855	95	226	3.8
2040E	10	950	95	231	4.1

Source: FAO, Standard Chartered Research estimates

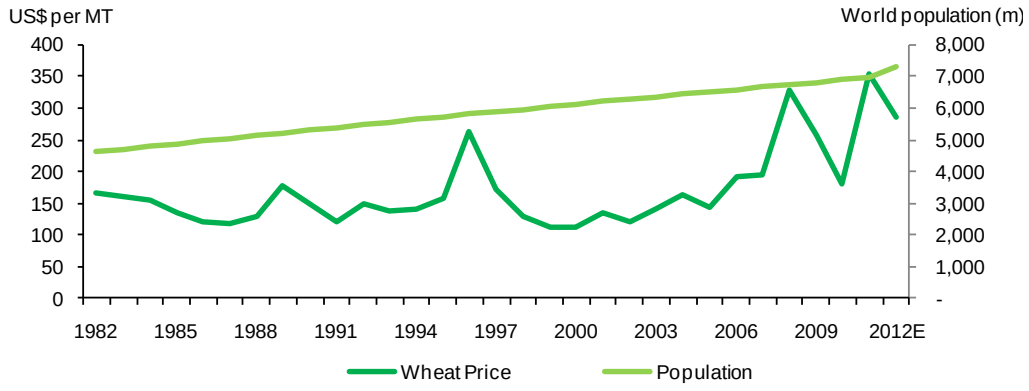
Even with our very cautious consumption estimates an additional 2m ha of land will be needed to cultivate the increased requirement of wheat as the population increases to 8 billion by 2020. An additional 14m ha will be needed by the time the world population reaches 10 billion in 2040. These are big numbers and the recent drought conditions in the US highlight the sensitivities to any supply disruptions. Part of the problem of wheat for new entrants is that at current prices of $7.72 per bushel and assuming productivity of 3.2 tonnes per hectare a farmer can only generate some US$900 per hectare of sales. After costs in countries like the US or Australia the profit is likely to be less than US$300 per hectare. So if a farmer is lucky enough to own 300 hectares of land, his cash profit will be less than $100,000 each year. Taxi drivers in Sydney earn twice that. Also for new frontiers like Africa, those economics do not add up at $7.72 per bushel because clearing large tracks of land is very difficult and then acquiring equipment and capital means the venture is likely to be negative NPV. Prices of wheat need to be substantially higher to justify new investment in Africa and South America.

Fig 64: Additional land required for wheat cultivation

	Population (bn)	Consumption (m tonnes)	Productivity per ha (t)	Additional land required for cultivation (m ha)	Cumulative land required for cultivation (m ha)
2020E	8	760	3.5	2	2
2030E	9	855	3.8	6	9
2040E	10	950	4.1	6	14

Source: Standard Chartered Research estimates

Fig 65: Population and the wheat price



Source: Indexmundi, Standard Chartered Research estimates

Soybean

Soya has an established place in Chinese and Japanese cuisine. However, its main use now is as an animal feed and the production of edible oil. Over the last 50 years soybean consumption has increased rapidly, by 5% YoY. It is one of the few commodities whose growth rate has not fallen in the last decade. We now consume 10 times the amount of soybean we did in 1960. Rising per-capita GDP, growing urban populations in low- and middle-income countries and the rising demand for meat, particularly in China and Africa ensure that this will be the case in the next 50 years as well.

Fig 66: Soybean cultivation

	World population (bn)	Consumption (m tonnes)	Total consumption per person (kg)	Land harvested (m ha)	Productivity per ha (t)
1960	3	27	9	24	1.1
1974	4	53	13	37	1.4
1987	5	100	20	53	1.9
1999	6	158	26	72	2.2
2011	7	262	36	102	2.6
2020E	8	288	36	127	2.8
2030E	9	324	36	153	3.1
2040E	10	360	36	180	3.3

Source: FAO, Standard Chartered Research estimates

Currently 102m ha are harvested at a yield of 2.6 tonnes per hectare to provide the 262mt of soybean that we need. Even if we assume 0% growth in per-capita consumption YoY compared with 5% historically, we would still need 288mt of soybean to feed a population of 8 billion by 2020. This means 25 million additional hectares; the size of all the farmland in Pakistan will be needed to meet this requirement, despite assuming a yield increase of 1% pa over 2011-2020. This is a big number.

The problem with soybeans is that yields are very low per hectare. A potato farmer in Scottsdale Tasmania can sometimes yield 70 tonnes of potatoes per hectare at a price of about $300 per tonne. That's revenue per hectare of $21,000. Although soya is significantly less water intensive and easier to grow, it still only yields 3-4 tonnes a hectare. Even at today's record price of $16 per bushel, that is revenue per hectare of just US$1,800. This model has worked okay in the past in Brazil because in those days labour costs were relatively low. Labour costs in Brazil are now rising quickly. It also has worked in the US because the farms are much bigger and highly mechanised. For new entrants in both Africa and even Brazil, the economics don't add up at $16 per bushel. In Brazil, much of the new land is found in states like Mato Grosso that are landlocked and over 1,000 kilometres from port. The transportation costs from Mato Grosso to the Asian consumer will be at least $100 per tonne, which is 15% of today's selling price.

Soybean cultivation requires moist, alluvial-rich soil and temperatures of 20-30 degrees Celsius. Finding additional land for soy cultivation is not without its challenges. Currently 90% of the world's soybean production comes from the US, China, Brazil, Argentina and India. It is impossible to imagine that the US will be able to find even a few million more hectares to devote to soya cultivation, and China and India make it increasingly more difficult to divert any rich habitable land to agriculture. The good news is that potential soy land exists, at least outside China and the US but prices need to be much higher to justify its development. The World Bank estimates that Brazil has some 22m ha of uncultivated land suitable for soy production, which could allow it to almost double its current capacity of 25m ha. We think this will take time to be unlocked given its distance from port.

Argentina is better positioned geographically to market and has some 10m ha of spare uncultivated land within six hours of market, which it could add to its current 18m ha of fields used for soy. In Africa, Sudan has 14m ha, while the Democratic Republic of Congo has 9m and the continent as a whole has 39m ha of potential soy land. The challenge in Latam, but perhaps more so in Africa, is that it will cost significantly more to bring this land to market. In addition, as we have previously discussed in relation to Africa, the relatively fragmented nature of land and complex land tenure systems, and eventual competition for acreage with other crops will add substantially to start-up costs.

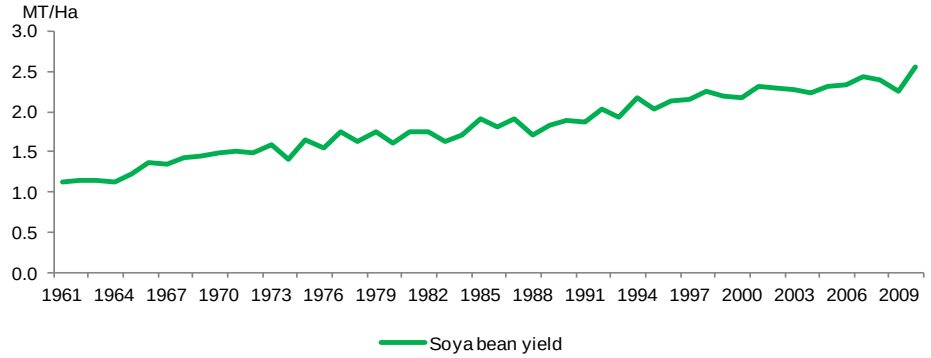
Fig 67: Additional land required for soybean cultivation

	Population (bn)	Consumption (m tonnes)	Productivity per ha (t)	Additional land required for cultivation (m ha)	Cumulative land required for cultivation (m ha)
2020E	8	288	2.8	25	25
2030E	9	324	3.1	26	51
2040E	10	360	3.3	27	78

Source: Standard Chartered Research estimates

Soybean yields have risen on a regular basis due to advances in genetically modified seeds. However, how much further can yields increase? The lack of available land to cultivate soya is likely to reduce yield gains, even though in our model we assume an aggressive 1% growth in yield pa from 2011-2020. We continue to assume the most optimistic yield scenario, otherwise the land required becomes too big.

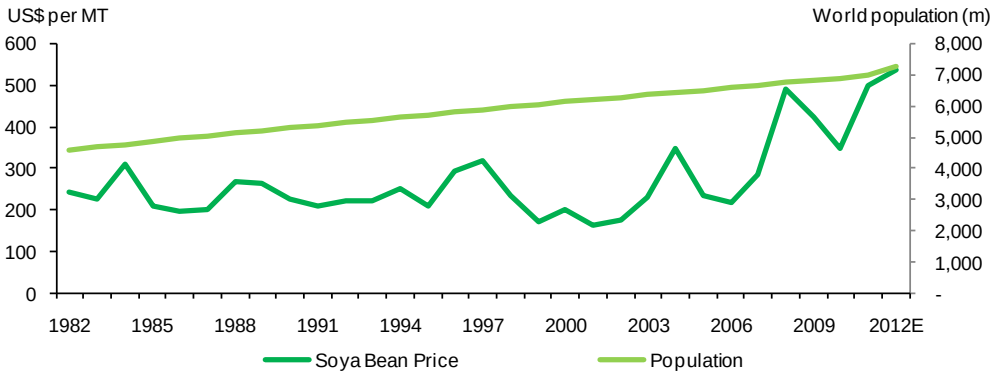
Fig 68: Soybean yield over time



Source: FAO, Standard Chartered Research estimates

The case for a bull market for soybeans is robust. On the supply side, there are pressures from limited output and competing demand for land in the US, Brazil and Argentina. Additionally, farm input costs are rising across the board. On the demand side, exponential population growth and steady growth in income levels will almost certainly result in increased demand for meat, and hence for soya meal as an animal feedstock. Overall, we expect the upward trend in soya prices to be sustained over time and the need for significant land makes it potentially one of the more exciting crops as we race to 8 billion people.

Fig 69: Population and the soybean price



Source: Indexmundi, Standard Chartered Research estimates

Sugar

The refined sugar that we eat is extracted from sugar beet and sugar cane. It is found in a plethora of every day products. While sugar may have a reputation as an unhealthy food, the cause of many illnesses such as diabetes, obesity, tooth decay, Alzheimer's disease, etc., it remains a staple additive to our daily diets. In the last few decades sugar has also taken up the healthier role of being a raw material for ethanol production. The consumption of sugar beet and sugar cane has increased by 70kg or 34% per person over the last 50 years.

Fig 70: Sugar beet and sugar cane consumption

	World Population (bn)	Consumption (m tonnes)	Total consumption per person (kg)	Land harvested (m ha)	Productivity per ha (t)
1960	3	608	203	16	38.0
1974	4	883	221	20	44.2
1987	5	1290	258	25	51.6
1999	6	1542	257	26	59.3
2011	7	1914	273	28	68.4
2020E	8	2184	273	30	74.0
2030E	9	2457	273	30	81.0
2040E	10	2730	273	31	87.7

Source: FAO, Standard Chartered Research estimates

Rising food consumption levels coupled with growing demand for ethanol as an alternative fuel is likely to further increase the requirement for sugar beet and sugar cane supply. Even if we assume that per-capita consumption of sugar and therefore sugar beet and sugar cane remains constant over the next three decades while yields increase by a generous 1% pa, we would still need to cultivate 270 million additional hectares of sugar beet and cane by 2020.

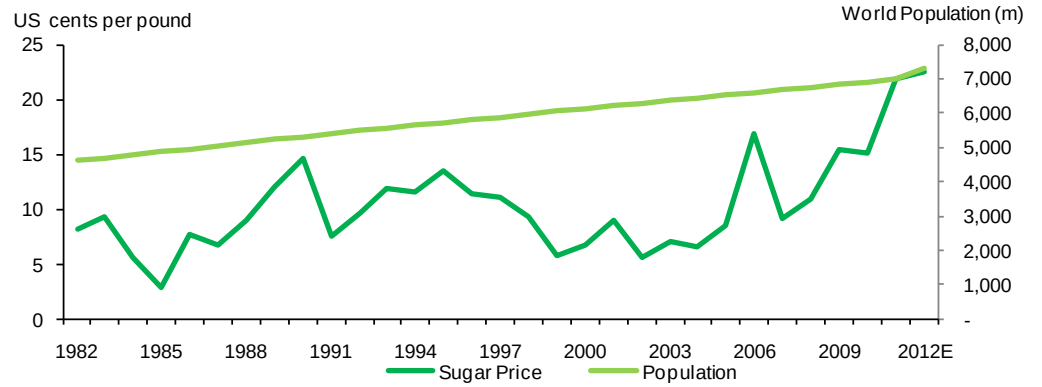
Fig 71: Additional land required for sugar beet and sugar cane cultivation

	Population (bn)	Consumption (m tonnes)	Productivity per ha (t)	Additional land required for cultivation (m ha)	Cumulative land required for cultivation (m ha)
2020E	8	2184	74.0	1.51	1.51
2030E	9	2457	81.0	0.84	2.35
2040E	10	2730	87.7	0.79	3.14

Source: FAO, Standard Chartered Research estimates

While sugar prices have been marked by volatility over the last few years, we firmly believe the price trajectory will remain upwards over time. A key reason for our longer-term bullish view on sugar is the deceleration in Brazil's sugar output and its adverse impact on sugar trade – a situation exacerbated by China's growing import needs. We believe there is now a stark realisation in the market that with the sugar trade continuously relying on Brazil, more investment in the country's sugar infrastructure is needed. Mill upgrades in Brazil have been hampered by cash flow constraints, particularly capacity increases in terms of the crush allocation for cane. Stakeholders on the ground note that while there is some investment in port infrastructure in Brazil (ie. Paranagua and Santos), not enough is being done on roads or new mills. They also voice concerns about how long sugar-cane output might take to recover to pre-2011/12 levels. Overall, we believe the sugar market must incentivise further output via plantings and investments in order to bolster global inventories. This is important for India and Brazil, but also for Thailand, where the government might encourage further sugar-cane plantings if its rice-support programme falters.

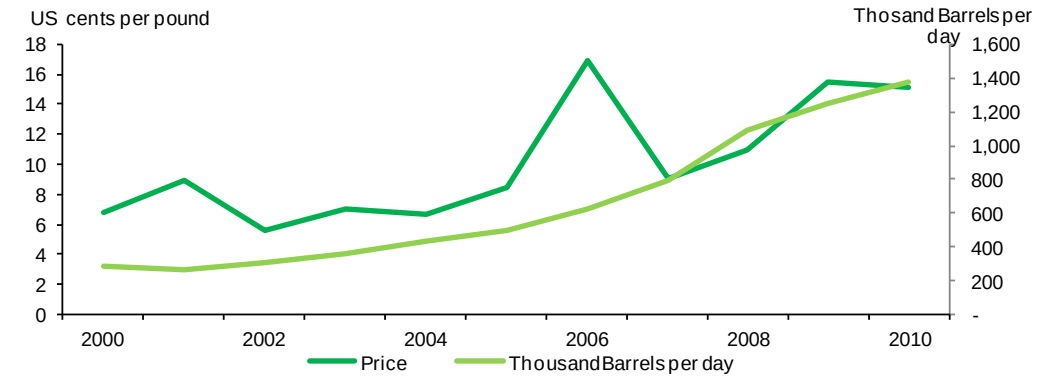
Fig 72: Population and sugar price



Source: Indexmundi, Standard Chartered Research estimates

We believe ethanol production has contributed significantly to the hike in sugar prices. As illustrated in the figure below, the sugar price and ethanol production have a correlation coefficient of 0.7.

Fig 73: Ethanol production and sugar prices



Source: Indexmundi, Standard Chartered Research estimates

Copper and gold are the big beneficiaries in metals

Copper – balanced end-use to support demand growth

Copper is likely to be a big winner of the population pressure theme, as it has been during the China era. Africa has a major building programme ahead of its long rise from poverty and the emerging middle class should ensure a very aggressive urbanisation programme over the next 20 years. Given the hot climate in much of Africa, prospects for a major uplift in demand for white goods and air conditioners are favourable.

Copper is the third-most-used metal in the world after steel and aluminium. Global copper consumption has increased five-fold in the last 50 years, from 4mt in 1960 to 19mt in 2011. While actual consumption has increased by 3.1% pa over the last 50 years, metal consumption per capita has increased by only 0.7%. Given its more balanced industrial and consumer usage, copper can be viewed as a late-cycle commodity compared with iron ore. Although we believe Africa's investment-driven demand over the next decade will not be as strong as China's in the last decade, consumer goods should be a significant driver for higher copper demand. The figure below illustrates that even though copper intensity is falling, the world still requires an additional 2mt of annual mined copper production by 2020. This is equivalent to two new Escondida mines (the world's largest copper mine in Chile). Given that this is an industry of falling grades and production this task is much harder than it sounds. Added to that, smaller copper producers or project stories looking to raise capital to build new copper mines are currently frozen due to very weak equity and debt markets since mid 2011.

Fig 74: Copper consumption – falling rate of intensity but 2mt still needed by 2020

	World population (bn)	Consumption (m tonnes)	Total consumption per person (kg)
1960	3	4	1.5
1974	4	7	1.8
1987	5	8	1.6
1999	6	13	2.1
2011	7	19	2.7
2020E	8	21	2.6
2030E	9	23	2.5
2040E	10	24	2.4

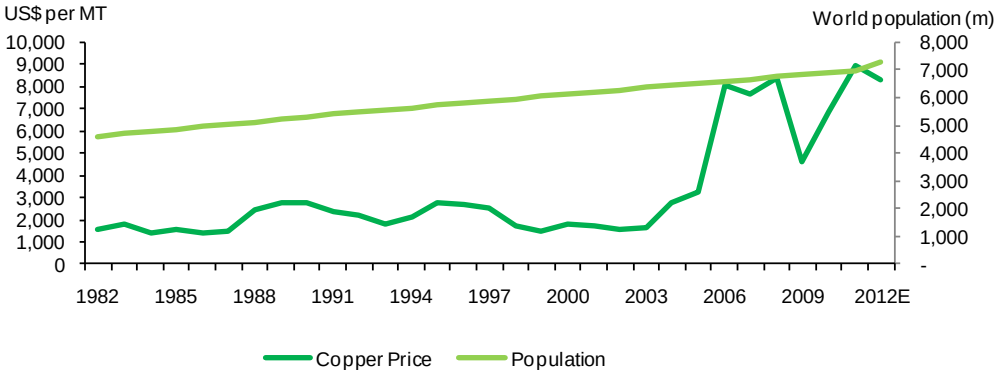
Source: Standard Chartered Research estimates

Our consumption forecast in the table above is the worst-case scenario, as we have assumed falling per-capita consumption growth against a historical trend of increasing per-capita consumption. Our commodities team forecasts long-term copper demand growth at 4.2% pa, which would imply global demand of 27mt by 2020 and 41mt by 2030 compared with our scenario of 21mt and 23mt demand, respectively, based on population. We agree with the house view, but just want to illustrate that even on the most conservative consumption forecasts per capita the industry is struggling to build enough new capacity.

Copper is the most constrained in terms of supply

Unlike commodities such as iron ore and thermal coal, copper resources are very constrained. There has been only one significant copper deposit discovery in the last 15 years. The average cost of discovery has increased and on average, it takes more than 10 years to develop a project. Moreover, ageing mines, falling grades and labour unrest have kept a lid on supply growth from existing mines, which we believe is likely to impact supply going forward. In the last 5 years, the industry has lost 800kt to 1mt of copper pa as a result of production misses.

Fig 75: Population and copper prices



Source: Indexmundi, Standard Chartered Research estimates

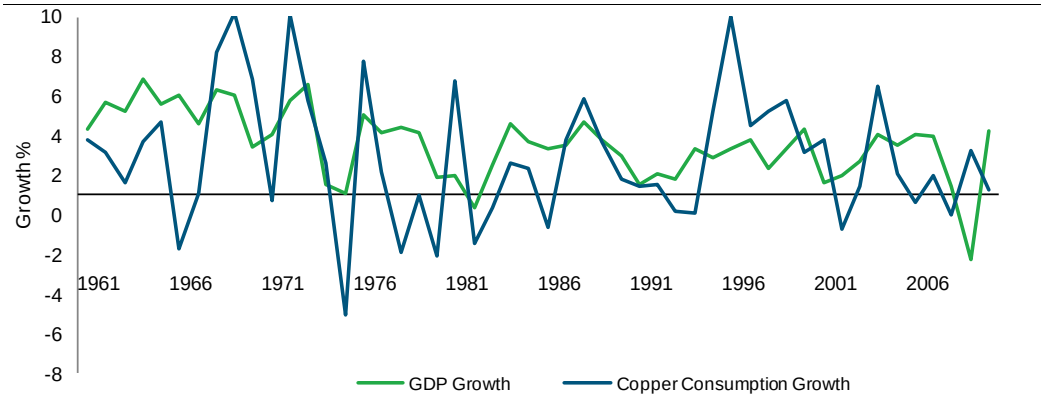
M&A to divert focus from organic growth

We believe copper-related companies could be among the most prominent in potential M&A-related activity within the mining industry. Mining companies have underinvested in growth projects since the 1997 Asian crisis. Even during the great China-led bull market from 2003-2008 very few projects were built. Those that were then planned to be built were then stopped because of the Lehman Crisis and now they have been stalled again due to the current financial crisis engulfing the debt and equity markets. The difficulty of finding new copper deposits has added to these woes. We detect a sense of urgency among mining companies to consolidate copper assets to secure future production growth. We believe the industry is on the verge of significant consolidation phase as mining companies strive to provide production growth to shareholders via acquisitions. Oyu Tolgoi and Las Bambas are the only significant projects expected to come on stream in the next 5 years, while the world needs two such projects every year.

Copper consumption to grow at 2% pa until 2020

We forecast copper consumption to grow from 19mt in 2012 to 21mt in 2020, averaging 1% growth pa. During the same period, we cautiously forecast copper consumption per capita to decline from 2.7kgs to 2.6kgs in the next 8 years. Looking beyond, we forecast copper demand to grow to 23mt by 2030 and 24mt by 2040, when the world population reaches 9 billion and 10 billion, respectively. We believe increased Chinese consumption and higher infrastructure spend in Africa and India are likely to be the key drivers for copper demand growth in the next two decades.

Fig 76: Global GDP and copper consumption



Source: World Bank, Standard Chartered Research estimates

Gold – remains the best hedging tool against inflation

Gold is the biggest winner among metals, in our view, from our population study. If our soft commodities forecast is correct, the world is about to enter a high inflation period. We believe gold will continue to be the key hedging tool against inflation. The 10-year bull market in gold we have seen so far could be a small part of the bigger super cycle in the yellow metal. We forecast gold consumption per capita to decrease from 0.54g per person in 2011 to 0.53g per person by 2020. Per-capita consumption in countries such as India and China is still very low, at some 0.7g per person compared with some of the developed countries such as the US, which consumes 1.4g of gold per person. We estimate total demand for gold to grow by 1% pa on average from 2011-2020. Given China's recent arrival as a gold buyer this number could be too low. In the last 6 months its rate of gold imports has risen to such an extent that at the current rate (from January to April 2012) it could account for 35% of global consumption this year. This is up from 19% just last year.

On the other hand, we expect only modest growth in gold mine supply in the next few years. We have analysed 375 gold mines and projects and our base-case 5-year production CAGR estimate is 3.6%.

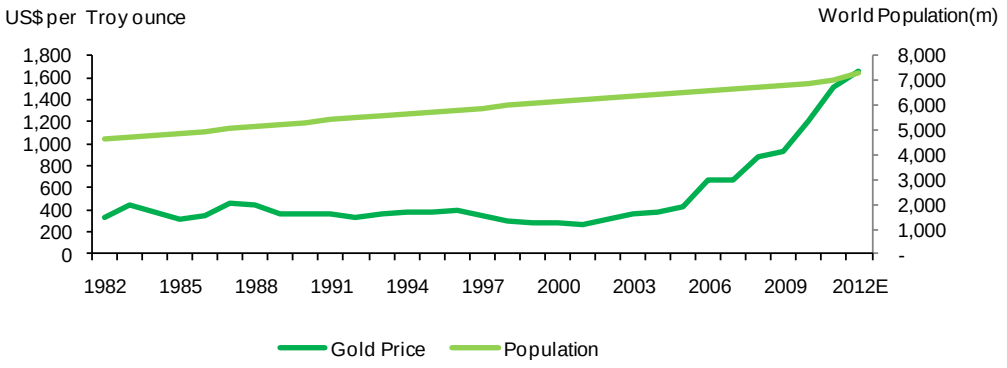
Fig 77: Gold consumption

	World population (bn)	Consumption (tonnes)	Total consumption per person (g)	Cumulative gold (tonnes)	Cumulative gold per person (g)
1960	3	1,190	0.4	86,000	29
1974	4	1,250	0.31	103,000	26
1987	5	1,660	0.33	121,000	24
1999	6	2,570	0.43	141,000	24
2011	7	3,780	0.54	165,000	24
2020E	8	4,240	0.53	190,000	24
2030E	9	4,680	0.52	215,000	24
2040E	10	5,100	0.51	240,000	24

Source: Standard Chartered Research estimates

In developing regions such as Africa, China and India wealth is increasing rapidly and their populations view gold as an important tool to hedge against inflation. China overtook India as the single-largest jewellery market in the world in H2 2011. Jewellery demand increased 69% YoY to 258.9 tonnes in 2011. India and China together accounted for 49% of total global demand and 55% of global jewellery demand in the same year.

Fig 78: Gold price and population



Source: Indexmundi, Standard Chartered Research estimates

Iron ore – may suffer from oversupply

The golden era of iron ore is almost over, in our view. Iron ore is abundantly available; its high price since 2006 sparked a plethora of new projects which could become operational in the next three years. On other hand, we do not see the urbanisation of Africa and India to be as iron ore-intensive as that of China in the last decade. The Chinese are looking to move their economy from investment-driven to consumer-driven which could lead to a softening of iron ore demand in the longer run.

Iron ore is integral to the global economy. Nearly all iron ore mined is used to manufacture steel. Iron ore consumption has increased five-fold in the last 50 years, and by 169% in the last 13 years, primarily on the back of Chinese urbanisation. Since 1998 consumption has grown by 7.4% pa compared with 3.1% pa since 1960. China's rapid rate of urbanisation caught the industry by surprise and iron ore producers were unable increase supply, following years of underinvestment in the industry.

Fig 79: Iron ore (Fe 62%) consumption

	World population (bn)	Consumption (m tonnes)	Total consumption per person (kg)
1960	3	522	174
1974	4	898	225
1987	5	903	181
1999	6	1,020	170
2011	7	1,400	200
2020E	8	1,520	190
2030E	9	1,620	180
2040E	10	1,700	170

Source: Standard Chartered Research estimates

Little supply growth near term but significant new capacity additions on the horizon

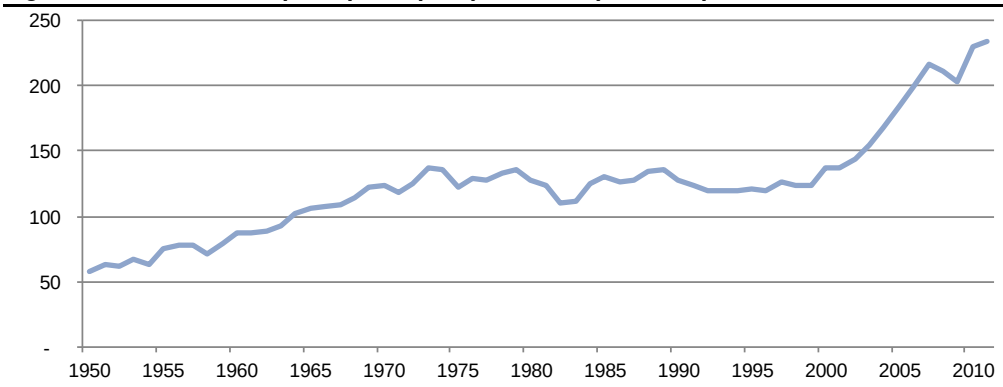
Currently, there is no shortage of iron-ore resources in the world. After years of underinvestment, iron ore seaborne supply failed to satisfy the demand growth resulting from Chinese urbanisation in the last 10 years; this led to a surge in prices. However, high prices have encouraged a range of new projects which could flood the industry with new capacity beyond 2015. There remain significant challenges to bring these new projects into production, namely capital and labour constraints, environmental issues and infrastructure bottlenecks. However, we think it has become a matter of 'when' rather than 'if' these projects are developed.

Africa and India yet to come to the iron ore party

Currently, the world consumes c.200kg of iron ore per capita. Developed economies, such as the US and Europe, consume more than 500kg per capita while China consumes 900kg per capita. The discrepancy is partly due to the US and Europe's greater use of recycled steel. Meanwhile, some of the less industrialised regions, such as India and Africa, consume less than 100kg of iron ore currently. We believe there is significant potential for these countries to increase consumption going forward as infrastructure investment rises. We assume world per-capita consumption to decrease by 1% pa conservatively in the next 8 years from 200kg in 2012 to 190kg in 2020. To put this into perspective, the per-capita consumption of iron ore increased by 1% in the last 13 years.

If China was the driver of iron ore consumption growth in the last decade, we believe Africa and India will be the key drivers in the next. However, we expect consumption growth to decelerate beyond 2020 as China matures, leading to a higher proportion of recycled steel, assuming a 15-20 year usage cycle.

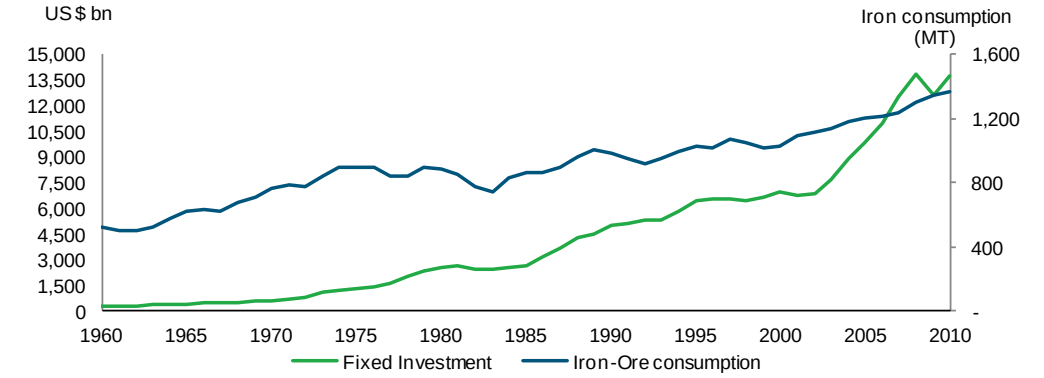
Fig 80: Iron ore consumption per capita (since 1950) – has it peaked? We think so



Source: Standard Chartered Research

We believe urbanisation in Africa and India could be the key driver of iron ore demand growth in the next decade. Currently, urbanisation rates for Africa and India are less than 40% and 30%, respectively. On the other hand, developed economies (Europe and North America) boast urbanisation of rates of 75% and China's urbanisation has risen from 30% to 51% in the last 15 years. The urbanisation process is metal intensive, as investment in infrastructure is likely to be the highest during that period, as illustrated in the chart below.

Fig 81: Fixed asset investment and global iron ore consumption

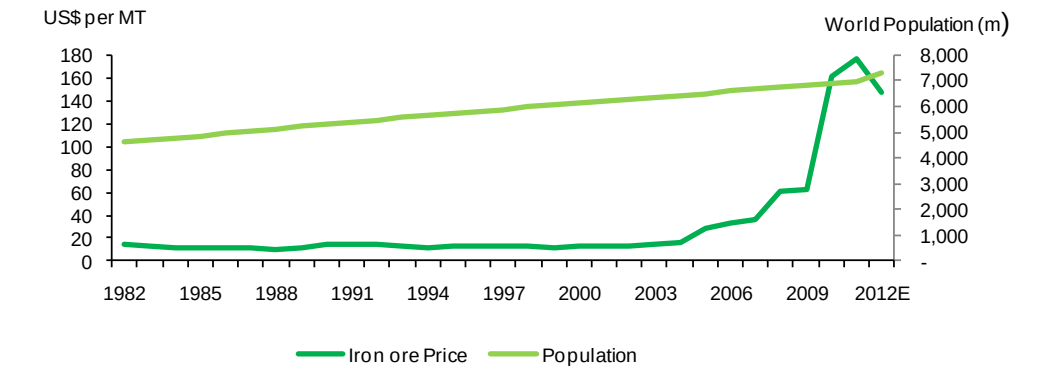


Source: World Bank, Standard Chartered Research

Iron ore prices to be supported by marginal costs

We estimate more than 350mt of domestic iron ore production in China, of which nearly 200mt is high-cost production. In the last 8 years the average Chinese Fe grade has fallen from 30% to 22%. This sharp decline in ore grades has been driven by the start-up of numerous low-grade mines to fill in the supply-demand gap in seaborne iron ore. We believe that it will be years before this high-cost production (well above US$100/t), which is currently supporting iron ore production on the downside, is phased out.

Fig 82: Population and iron ore prices



Source: Indexmundi, Standard Chartered Research

Oil – shale supply to rise

We believe oil's dominance as an energy source and important commodity governing geopolitical relations is coming to an end. While it will be a long time before any other source of energy replaces oil, alternative energy sources are making rapid inroads, buoyed by tax incentives and carbon credits offered by governments worldwide. Meanwhile, technological innovations in the last decade have added another source of oil (from shale). We forecast oil supply to improve, driven by shale oil, and the supply/demand deficit gap in the US to narrow to 4 million barrels per day (mmbd) by 2025 from 10.7mmbd currently. However, unlike many market experts, we believe the US will not be self-sufficient in oil in the next decade. By 2025, we believe the US will still import 22% of its oil needs.

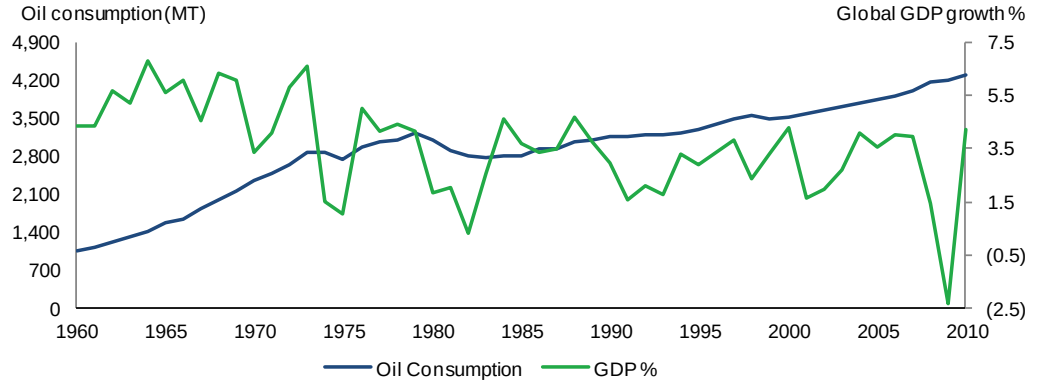
Fig 83: Oil consumption

	World population (bn)	Consumption (m tonnes)	Total consumption per person (kg)
1960	3	1,050	350
1974	4	2,877	719
1987	5	2,948	590
1999	6	3,482	580
2011	7	4,351	622
2020E	8	4,800	600
2030E	9	5,310	590
2040E	10	5,800	580

Source: BP World Energy Review 2011, Standard Chartered Research estimates

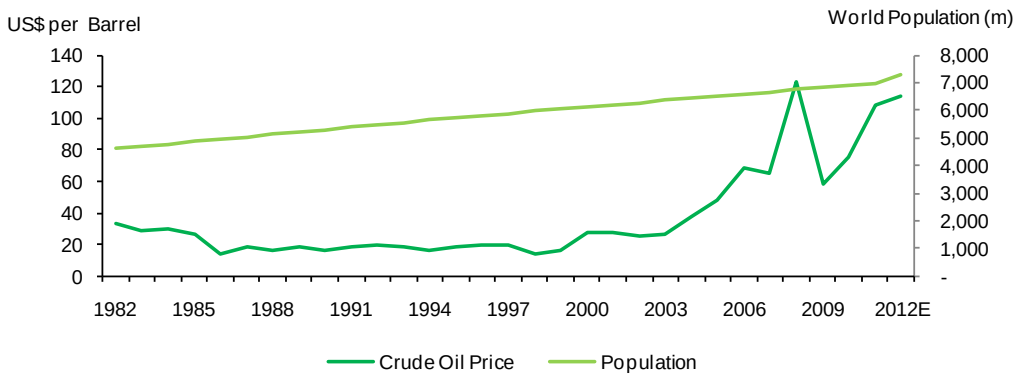
We estimate per-capita consumption of oil to decline from 622kg currently to 600kg by 2020. This is a 0.4% decline over the next 8 years compared with 1% pa increase over the last 13 years. However, overall consumption is still likely to increase by 10% from 2012-2020.

Fig 84: Global GDP and oil consumption



Source: Indexmundi, Standard Chartered Research

Fig 85: Oil price and population



Source: World Bank, Standard Chartered Research estimates

Land supply and demand – worrying outlook

- We assume historical yield growth since 1961 will continue as the world's population grows to 10 billion people. This is equivalent to an annual yield improvement of 1%
- We assume 0% per-capita consumption for all commodities, which is a departure from the more aggressive growth forecasts witnessed since 1961
- The world would still need new agricultural land equivalent to the size of India or Russia by 2020, assuming 0% consumption growth per capita
- If per-capita consumption continues to rise at historical rates, by 2020 we would need new agricultural land equivalent to size of the entire US farmland under cultivation

Land is finite and while property developers can build apartments to the sky, good-quality farm land is declining every year. In the last 10 years, agricultural land supply has fallen by some 1% (FAO). As the world approaches 8 billion consumers we assume land supply will fall by some 135m ha, which is 3% of the current supply of 4.1 billion hectares of agriculture land. The pressures on land are obvious. Urban sprawl is occurring in cities across the globe. Land is being reclaimed for housing and industry while at the same time existing farm land is being depleted and suffers from nearly 3 decades of overcropping, which is now putting pressure on yields. The figure below illustrates our forecast supply and demand model. By 2020 as we reach 8 billion inhabitants we think the world will need an additional 218m ha to plant extra wheat, corn, rice, soya, palm, rubber, coffee and coca. Beef output will also need to increase and an extra 29m ha will be needed to satisfy demand. This is assuming 0% consumption growth per person.

Fig 86: What does it all mean for the growing pressure on land?

	2011	2020E	2030E	2040E
Population (m)	**7,000**	**8,000**	**9,000**	**10,000**
Existing agricultural land supply (m hectares)	4,189	4,054	3,934	3,829
Scenario 1: 0% growth in per-capita consumption (m ha)				
Land required	0	218	437	643
Increase in green house gas emissions per year* (CO2 tonnes)		1,349	2,806	4,129
Land left to cultivate; in Africa (600m ha), in South America (600m ha)	1,200	982	763	557
Scenario 2 (worrying): Historical growth rate in per-capita consumption				
Land required	0	373	852	1,358
Increase in green house gas emissions per year*(CO_2 tonnes)		2,395	5,472	8,721
Land left to cultivate; in Africa (600m ha), in South America (600m ha)	1,200	827	348	-158

* Carbon dioxide emissions that would not be captured as a result of cutting down mature trees
Source: Standard Chartered Research estimates

Our supply and demand analysis paints a frightening picture as the global population rises to 8 billion. By 2020 we require 218m ha of additional agricultural land. This is assuming 0% consumption growth but optimistic yield improvements of 1% pa for every crop that we analyse. Based on the same assumptions as we approach 9 billion inhabitants, the need for new farmland could balloon to 437m ha, which is the equivalent of one US and one Brazil. In short something has to give. Yields need to rise even faster, food wastage needs to fall and prices need to increase significantly to encourage greater use of irrigation and/or fertiliser. In reality, events rarely pan out this way given the political pressure that arises as consumers demand lower prices.

Large-scale deforestation required, but undesirable

African and South American jungle deforestation appears to be the only way to meet the growing demand for food. We believe there is potential to add about 600m ha of new agricultural land in both of Africa and South America. Anything beyond that would be difficult, as the remaining forest land is protected. About 40% of the 520m ha Amazon rainforest in South America and c.5% of the remaining approximately 650m ha of forest land in Africa are protected. Even 1,000m ha would come at a huge cost to the world's eco system, as all of the cultivable land that is available now and then some rainforest will have to be cleared to grow crops. The situation is more alarming when you consider that even more land will be required for mining, logging and dwelling purposes by the expanding population.

Greenhouse effect

In 2009 the world emitted 28,994mt of carbon dioxide, with China and the US accounting for 6,877mt and 5,195mt, respectively (IEA – CO_2 emissions from fuel combustion, 2011 Edition). An acre of mature trees can capture 2.6 tonnes of CO_2 per year (www.treesintrust.com); accordingly, the felling of 218m ha of forest land by 2020 would result in nearly 1,400mt of uncaptured CO_2; this is almost equal to the entire amount of CO_2 emitted by the Russian Federation in 2009.

Fig 87: Top 10 producing countries represent 51% of world agricultural land supply (2012)

	Agricultural land area (m ha)	As a % of total land
China	308	33%
Australia	409	53%
US	373	41%
Brazil	264	31%
Russia	216	13%
India	180	61%
Argentina	140	51%
South Africa	121	82%
Canada	68	7%
Indonesia	54	30%

Source: FAO, Standard Chartered Research estimates

The above illustrates the supply of land for the 10 most agriculturally productive countries. These 10 countries represent 51% of the total land area, which is currently around 4,189m ha.
The figure below provides a detailed breakdown of land usage globally. We split it between land used for crops and land used for livestock.

Our demand forecasts are based on the same analysis we used in the section 'Future demand forecasts: A study by commodity'. If prices for some of these commodities are to increase at a much faster rate, then consumption rates will be affected. Food wastage will fall significantly if food prices increase but for modelling purposes we do not factor this in for now. While all indications are that agricultural productivity has peaked, as we elaborate in the 'Peak yield' section, we have assumed a 1% increase in yield pa for all commodities. However, we have assumed that the livestock yield remains constant over time, as even more scarce food resources would be needed to increase it.

Fig 88: Global agriculture land demand and supply based on 0% growth in per capita consumption

	2011	2020E	2030E	2040E
Population (m)	**7,000**	**8,000**	**9,000**	**10,000**
Agriculture land supply (m ha)	4,189	4,054	3,934	3,829
Demand (m ha)				
Total harvest crop area (sub-total)	**1,275**	**1,317**	**1,361**	**1,404**
Wheat	217	219	226	231
Corn	168	178	183	188
Rice	154	156	161	165
Soybeans	102	127	153	180
Oil palm fruit	16.9	17.6	18.1	18.6
Cocoa beans	8.7	9.4	9.7	10.0
Sugar beet and cane	28.0	29.5	30.3	31.1
Other	580	580	580	580
Animals/Livestock	**1,762**	**1,802**	**1,858**	**1,916**
Cattle	1,429	1,458	1,502	1,546
Sheep	181	182	182	183
Chicken	55	57	61	65
Pigs	97	105	113	122
Others	**1,152**	**1,152**	**1,152**	**1,152**
Balance/(Deficit) (m ha)	**0**	**-218**	**-437**	**-643**

Source: FAO, Standard Chartered Research estimates

The figure above is by no means an exhaustive list of crops and livestock that are grown or reared on agriculture land. It is an example of how the demand for certain key agricultural products will increase with population growth and its effect on agricultural land demand. We could argue that the requirement would be far higher than illustrated in the table if we were to expand the list to include more crops and livestock.

A more realistic scenario

The above mentioned scenario is the most conservative possible forecast of per-capita consumption coupled with an aggressive per-annum gain in yield growth. However, with increasing income levels as more people join the middle class, this is likely to result in a consumption boom. Therefore, we believe the following forecasts are more realistic but also more worrying.

Fig 89: Realistic per-capita consumption growth pa

	Historical growth (last 50 years)	Historical growth (last 10 years)	Our forecast (2012-40E)
Pork	3%	2%	2%
Beef	2%	1%	1%
Wheat	3%	2%	2%
Chicken	5%	4%	4%
Rice	2%	1%	1%
Corn	3%	4%	3%
Palm oil	6%	6%	6%
Cocoa	3%	3%	3%
Soya	5%	5%	5%
Sugar	2%	3%	2%

Source: Standard Chartered Research estimates

We arrive at the following land requirement forecasts using the above mentioned consumption forecasts and a yield gain of 1% pa. On this basis, as the global population reaches 10 billion the world will need to find another 1.38 billion hectares of agricultural land, which is more than the current spare capacity in both Africa and South America.

Fig 90: Global land demand and supply – an alarming but more realistic scenario

	2011	2020E	2030E	2040E
Population (m)	**7,000**	**8,000**	**9,000**	**10,000**
Agricultural land supply (m ha)	4,189	4,054	3,934	3,829
Demand (m ha)				
Total harvest crop area	1,275	1,434	1,649	1,893
Wheat	217	257	316	380
Corn	168	226	303	394
Rice	154	169	190	211
Soybeans	102	127	153	180
Oil palm fruit	17	28	49	80
Cocoa beans	9	12	16	16
Sugar cane and beet	28	35	43	52
Other	580	580	580	580
Animals/Livestock				
Cattle	1,429	1,479	1,560	1,643
Sheep	181	182	182	183
Chicken	55	68	93	127
Pigs	97	111	149	186
Other	1,152	1,152	1,152	1,152
Additional land required (m ha)	**0**	**-373**	**-852**	**-1,358**

Source: FAO, Standard Chartered Research estimates

Appendix 1: Forecast methodology

Population growth forecasts

We are by no means population experts and we understand there have been dozens of studies on this subject. However, one of the key differences is that we are not buying into the notion that China's population growth will slow from 1-1.5% in the last 20 years to negative 0.2% by 2030 as forecast by the UN. We assume its growth will fall to around zero by 2030. The same applies to India, where the UN has assumed the population slows to a long-term rate of 0.7%. We assume India will slow from 1.75% in the last 20 years to 1.2% by 2030. For Africa, our longer-term forecasts are broadly in line with the UN. In reality we will not know the answer for some time but we believe that the concept that the world population will not reach 10 billion until 2050 is wishful thinking. Our target of 2040 could be too early; irrespective of who is right, our study is concerned more with the impact of population on commodity prices and land supply and demand. Why do we think we will reach 10 billion population by 2040?

- Of the 56 countries in Africa, fewer than 26 have conducted a population census within the last 8 years; therefore we estimate that Africa's real population is closer to 1.17 billion than consensus estimates of around 1.1 billion based on a very reasonable growth rate of c.2.3% over the last few years for Africa.
- Infant mortality rates and life expectancy is improving on the back of better medical facilities and more importantly infant vaccinations.
- Improving income levels result in better nutrition and longer, healthier lives, especially in regions such as India and Africa.
- Africa, similar to India, has a very young population; some 55% of the population is under 24 years old. The child-bearing age of this section of the population has yet to come. On the other hand, we expect birth rates to decline on improving wealth, leading to population growth (net) of 1.85% by 2030 from 2.3% currently.

Even assuming conservative UN population growth rates, our analysis shows that there will be a shortage of land and commodities as shown in our risk section above.

Land supply-demand forecasts

Our forecasts for land usage and future required land amounts are derived from the following:

- We estimate the current supply of global agriculture land to be 4.1 billion hectares. Agricultural land comprises arable land, permanent crop area and permanent meadows and pastures. According to the Food and Agriculture Organisation of the United Nations (FAO), the world has 4.8m ha of agricultural land. The FAO estimates agricultural land to represent 56% of China's total land area, 77% of Kazakhstan's and 58% of Sudan's. However, based on our detailed research and investigation, we believe agricultural land as a percentage of total land is 33%, 28% and 33%, respectively, which is in line with the study conducted by the Lincoln Institute of Land and Policies and many other independent studies.
- Furthermore, we assume that an additional 1 billion people results in the loss of 120m ha of agricultural land to urbanisation and other use, or the loss of 15m ha pa. We believe this is conservative, as the UN estimates we currently lose as much as 30m ha of farmland to industrialisation and urbanisation every year.
- On the demand side, we have assumed 0% per-capita consumption growth for commodities going forward and 1% pa yield improvements. To put this into perspective, per-capita consumption of commodities has risen by between 1% and 6% in the last decade and yield improvements have been on a declining trend in the last 50 years; in the last decade the average yield improvement has been 1%.

Appendix 2: Our population forecasts

Fig 91: Population guide by decade, 1950–2040

millions	1950	1960	1970	1980	1990	2000	2010	2012E	2020E	2030E	2040E
China	551	658	815	983	1145	1269	1341	1350	1440	1537	1534
India	372	448	554	700	874	1054	1225	1250	1408	1604	1731
United States	158	186	209	230	253	282	310	325	347	370	388
Indonesia	75	92	118	151	184	213	240	250	273	309	338
Nigeria	38	46	57	76	98	124	158	200	248	312	325
Pakistan	38	46	59	80	112	145	194	200	234	285	334
Brazil	54	73	96	122	150	174	195	210	223	233	318
Bangladesh	38	50	67	81	105	130	179	160	180	212	238
Russia	103	120	130	139	148	147	143	143	141	137	133
Japan	82	93	104	116	122	126	127	127	125	121	116
Mexico	28	38	52	69	84	100	113	118	128	137	142
Philippines	18	26	35	47	62	77	93	98	115	141	165
Vietnam	28	35	45	54	67	79	88	92	104	124	140
Ethiopia	18	23	29	35	48	66	83	90	110	136	161
Egypt	22	28	36	45	57	68	81	86	101	119	136
Germany	68	73	78	78	79	82	82	82	81	80	78
Turkey	21	28	35	44	54	64	73	78	85	90	90
Iran	17	22	29	39	55	65	74	80	86	89	95
DR of Congo	12	15	20	27	36	50	66	70	87	110	134
Thailand	21	27	37	47	57	63	69	75	77	79	130
UK	51	53	56	56	57	59	62	65	68	71	73
France	42	46	51	54	57	59	63	65	67	70	73
Italy	46	50	53	56	57	57	61	63	63	63	62
South Africa	14	17	23	29	37	45	50	60	63	67	69
Tanzania	8	10	14	19	25	34	45	48	63	83	105
Colombia	12	16	21	27	33	40	46	50	55	59	58
Myanmar	17	21	26	33	39	45	48	50	53	56	61
South Korea	19	25	31	37	43	46	48	47	48	48	48
Sudan	9	12	15	20	26	34	44	55	68	86	103
Spain	28	30	34	37	39	40	46	45	47	48	37
Ukraine	37	43	47	50	52	49	45	47	45	43	79
Kenya	6	8	11	16	23	31	41	43	54	69	85
Argentina	17	21	24	28	33	37	40	41	44	46	48
Uganda	5	7	9	13	18	24	33	38	50	68	86
Algeria	9	11	14	19	25	31	35	40	45	51	57
Poland	25	29	33	36	38	38	38	40	40	40	74
Canada	14	18	22	25	28	31	34	36	39	41	43
Iraq	6	7	10	14	17	24	32	34	43	54	65
Afghanistan	8	10	12	14	13	23	31	32	41	51	59
Morocco	9	12	15	20	25	29	32	32	36	40	42
Nepal	8	10	12	15	19	24	30	31	35	39	42
Uzbekistan	6	9	12	16	21	25	27	29	32	35	41
Venezuela	5	8	11	15	20	24	29	29	33	36	37
Peru	8	10	13	17	22	26	29	29	32	34	39
Malaysia	6	8	11	14	18	23	28	28	32	35	39
Saudi Arabia	3	4	6	10	16	20	27	30	35	40	36
Mozambique	6	8	9	12	14	18	23	27	33	40	48
Yemen	4	5	6	8	12	18	24	27	34	43	51

Source: UN data, Standard Chartered Research estimates

Fig 91: Population guide by decade, 1950–2040, (cont'd)

millions	1950	1960	1970	1980	1990	2000	2010	2012	2020	2030	2040
Ghana	5	7	9	11	15	19	24	25	30	37	43
Angola	4	5	6	8	10	14	19	28	35	45	56
Côte d'Ivoire	3	4	5	9	13	17	20	23	28	35	42
Cameroon	4	5	7	9	12	16	20	23	27	33	39
Dem. People's Republic of Korea	10	11	14	17	20	23	24	23	24	24	18
Madagascar	4	5	7	9	11	15	21	24	30	39	48
Other non-specified areas	8	10	15	18	20	22	23	21	21	21	21
Romania	16	18	20	22	23	22	21	21	20	20	29
Australia	8	10	13	15	17	19	22	26	29	31	38
Sri Lanka	8	10	13	15	17	19	21	25	26	27	38
Syrian Arab Republic	3	5	6	9	12	16	20	26	30	34	43
Niger	2	3	4	6	8	11	16	17	23	32	42
Burkina Faso	4	5	6	7	9	12	16	20	26	34	42
Malawi	3	4	5	6	9	11	15	17	22	29	36
Chile	6	8	10	11	13	15	17	16	17	18	18
Zambia	2	3	4	6	8	10	13	20	26	34	43
Mali	5	5	6	7	9	11	15	17	22	29	36
Netherlands	10	11	13	14	15	16	17	18	18	19	37
Kazakhstan	7	10	13	15	17	15	16	15	16	17	23
Guatemala	3	4	5	7	9	11	14	15	18	22	18
Ecuador	3	4	6	8	10	12	14	14	16	17	17
Cambodia	4	5	7	7	10	12	14	17	19	20	36
Guinea	3	4	4	4	6	8	10	13	16	20	25
Chad	2	3	4	5	6	8	11	11	14	18	21
Tunisia	4	4	5	6	8	9	10	13	14	16	17
Senegal	2	3	4	5	7	10	12	11	14	18	22
Somalia	2	3	4	6	7	7	9	11	14	17	21
Greece	8	8	9	10	10	11	11	11	12	12	20
Rwanda	2	3	4	5	7	8	11	11	14	18	23
Cuba	6	7	9	10	11	11	11	11	11	10	10
Zimbabwe	3	4	5	7	10	13	13	13	15	18	20
Belgium	9	9	10	10	10	10	11	11	11	11	10
Portugal	8	9	9	10	10	10	11	14	14	14	24
Czech Republic	9	10	10	10	10	10	10	10	10	10	12
Bolivia	3	3	4	5	7	8	10	10	11	13	14
Dominican Republic	2	3	5	6	7	9	10	10	11	12	12
Hungary	9	10	10	11	10	10	10	10	10	10	10
Serbia	7	8	8	9	10	10	10	10	10	10	9
Haiti	3	4	5	6	7	9	10	10	11	12	8
Belarus	8	8	9	10	10	10	10	12	12	11	25
Sweden	7	7	8	8	9	9	9	9	10	10	10
Azerbaijan	3	4	5	6	7	8	9	9	10	11	11
Benin	2	2	3	4	5	7	9	9	11	15	18
Burundi	2	3	4	4	6	6	8	9	10	12	14
Austria	7	7	7	8	8	8	8	8	8	9	9
Sierra Leone	2	2	3	3	4	4	6	8	9	11	13
Hong Kong SAR	2	3	4	5	6	7	7	8	8	9	13

Source: UN data, Standard Chartered Research estimates

Fig 91: Population guide by decade, 1950–2040, (cont'd)

millions	1950	1960	1970	1980	1990	2000	2010	2012E	2020E	2030E	2040E
United Arab Emirates	0.07	0.09	0.23	1.02	1.81	3.03	7.51	7.70	8.71	9.85	7.67
Honduras	1.49	2.00	2.69	3.63	4.89	6.22	7.60	7.60	8.82	10.10	10.20
Switzerland	4.67	5.30	6.17	6.30	6.67	7.17	7.66	7.40	7.60	7.74	5.82
Israel	1.26	2.09	2.85	3.75	4.50	6.01	7.42	8.00	9.01	10.09	9.18
Bulgaria	7.25	7.87	8.49	8.86	8.82	8.01	7.49	7.00	6.62	6.16	10.79
Eritrea	1.14	1.42	1.85	2.47	3.16	3.67	5.25	7.00	8.90	11.56	14.30
Papua New Guinea	1.71	1.97	2.43	3.22	4.16	5.38	6.86	6.60	7.79	9.21	8.59
Tajikistan	1.53	2.08	2.94	3.95	5.30	6.17	6.88	7.00	7.87	8.82	8.10
Lao People's Democratic Republic	1.68	2.13	2.69	3.23	4.19	5.32	6.20	6.30	6.96	7.61	8.95
Libya	1.03	1.35	1.99	3.06	4.33	5.23	6.36	7.00	7.35	7.71	7.87
Paraguay	1.47	1.91	2.48	3.19	4.24	5.34	6.45	6.20	7.05	7.95	6.82
Jordan	0.45	0.90	1.67	2.30	3.42	4.83	6.19	6.20	7.07	7.98	9.21
Togo	1.40	1.58	2.10	2.67	3.67	4.79	6.03	8.00	9.54	11.52	13.34
El Salvador	2.20	2.77	3.74	4.66	5.33	5.94	6.19	5.90	6.23	6.64	7.12
Nicaragua	1.29	1.77	2.40	3.24	4.12	5.07	5.79	5.60	6.21	6.76	5.58
Denmark	4.27	4.58	4.93	5.12	5.14	5.34	5.55	5.50	5.64	5.78	5.37
Slovak Republic	3.44	4.09	4.51	4.96	5.27	5.40	5.46	7.00	7.08	7.09	12.18
Kyrgyzstan	1.74	2.17	2.96	3.63	4.39	4.95	5.33	5.40	5.96	6.55	7.03
Finland	4.01	4.43	4.61	4.78	4.99	5.17	5.36	5.40	5.52	5.61	5.62
Singapore	1.02	1.63	2.07	2.41	3.02	3.92	5.09	5.20	5.54	5.88	6.06
Turkmenistan	1.21	1.59	2.19	2.86	3.67	4.50	5.04	5.10	5.60	6.04	6.31
Liberia	0.91	1.12	1.44	1.92	2.13	2.85	3.99	4.90	5.97	7.39	8.75
Congo	0.81	1.01	1.34	1.80	2.39	3.14	4.04	4.70	5.59	6.72	7.76
Norway	3.27	3.58	3.88	4.09	4.24	4.49	4.88	4.50	4.74	5.03	5.08
Costa Rica	0.97	1.33	1.82	2.34	3.07	3.92	4.66	4.50	4.95	5.31	6.65
Bosnia and Herzegovina	2.66	3.18	3.56	3.91	4.31	3.69	3.76	4.50	4.38	4.20	6.50
Central African Republic	1.33	1.50	1.83	2.27	2.93	3.70	4.40	4.40	5.22	6.26	7.21
Ireland	2.91	2.83	2.96	3.42	3.53	3.80	4.47	4.30	4.66	5.00	3.33
New Zealand	1.91	2.37	2.82	3.15	3.40	3.86	4.37	4.30	4.65	4.99	4.58
Croatia	3.85	4.05	4.17	4.38	4.52	4.51	4.40	4.20	4.13	4.02	7.45
Lebanon	1.44	1.91	2.46	2.79	2.95	3.74	4.23	5.00	5.26	5.46	8.23
Georgia	3.53	4.16	4.71	5.07	5.46	4.75	4.35	5.00	4.74	4.40	8.82
Occupied Palestinian Territory	0.93	1.07	1.12	1.51	2.08	3.20	4.04	4.60	5.73	7.12	3.57
Puerto Rico	2.22	2.36	2.72	3.20	3.53	3.81	3.75	3.70	3.70	3.71	3.70
Panama	0.86	1.13	1.51	1.95	2.42	2.96	3.52	3.60	4.01	4.43	4.74
Mauritania	0.66	0.85	1.13	1.52	2.00	2.64	3.46	3.50	4.25	5.24	6.18
Republic of Moldova	2.34	3.00	3.59	4.01	4.36	4.11	3.57	3.50	3.34	3.15	5.83
Uruguay	2.24	2.54	2.81	2.91	3.11	3.32	3.37	3.40	3.50	3.60	3.66
Lithuania	2.57	2.77	3.14	3.43	3.70	3.50	3.32	3.30	3.20	3.09	2.98
Albania	1.22	1.61	2.14	2.67	3.29	3.07	3.20	3.20	3.27	3.27	3.20
Armenia	1.35	1.87	2.52	3.10	3.54	3.08	3.09	3.10	3.14	3.10	3.05
Oman	0.46	0.56	0.73	1.18	1.87	2.26	2.78	3.00	3.40	3.70	3.84
Kuwait	0.15	0.26	0.75	1.38	2.09	1.94	2.74	2.80	3.29	3.82	4.31
Mongolia	0.78	0.96	1.28	1.69	2.19	2.41	2.76	2.80	3.14	3.44	3.67
Jamaica	1.40	1.63	1.87	2.13	2.36	2.58	2.74	2.80	2.87	2.89	2.83
Namibia	0.49	0.60	0.78	1.01	1.41	1.90	2.28	2.30	2.66	3.11	3.50
Lesotho	0.73	0.85	1.03	1.31	1.64	1.96	2.17	2.20	2.42	2.67	2.85
Latvia	1.95	2.13	2.37	2.51	2.66	2.38	2.25	2.20	2.14	2.05	2.62
Former Yugoslav Republic of Macedonia	1.23	1.39	1.57	1.79	1.91	2.01	2.06	2.10	2.11	2.08	2.03
Botswana	0.41	0.52	0.69	1.00	1.38	1.76	2.01	2.00	2.14	2.28	2.37
Slovenia	1.47	1.58	1.67	1.83	1.93	1.99	2.03	2.00	2.03	2.02	2.36

Source: UN data, Standard Chartered Research estimates

Fig 91: Population guide by decade, 1950–2040, (cont'd)

millions	1950	1960	1970	1980	1990	2000	2010	2012E	2020E	2030E	2040E
Qatar	0.02	0.05	0.11	0.22	0.47	0.59	1.76	1.90	2.15	2.31	2.44
The Gambia	0.27	0.37	0.46	0.63	0.97	1.30	1.73	1.80	2.27	2.92	3.59
Guinea-Bissau	0.52	0.59	0.60	0.83	1.02	1.24	1.52	1.50	1.79	2.17	2.52
Gabon	0.47	0.49	0.53	0.68	0.93	1.24	1.51	1.50	1.74	2.04	2.31
Bahrain	0.12	0.16	0.21	0.36	0.49	0.64	1.26	1.30	1.44	1.57	1.28
Mauritius	0.49	0.66	0.83	0.96	1.06	1.20	1.30	1.30	1.34	1.38	1.39
Trinidad and Tobago	0.64	0.84	0.97	1.08	1.22	1.29	1.34	1.30	1.32	1.31	1.67
Estonia	1.10	1.22	1.37	1.47	1.57	1.37	1.34	1.30	1.29	1.26	1.36
Democratic Republic of Timor-Leste	0.43	0.50	0.60	0.58	0.74	0.83	1.12	1.20	1.53	1.96	1.56
Swaziland	0.27	0.35	0.45	0.60	0.86	1.06	1.19	1.20	1.31	1.43	1.51
Cyprus	0.49	0.57	0.61	0.69	0.77	0.94	1.10	1.10	1.20	1.32	1.44
Djibouti	0.06	0.08	0.16	0.34	0.56	0.73	0.89	0.90	1.06	1.26	1.44
Réunion	0.25	0.34	0.46	0.51	0.61	0.74	0.85	0.90	1.00	1.12	1.21
Fiji	0.29	0.39	0.52	0.64	0.73	0.81	0.86	0.90	0.95	0.98	1.07
Comoros	0.16	0.19	0.24	0.33	0.44	0.56	0.73	0.80	0.98	1.22	1.46
Guyana	0.41	0.56	0.72	0.78	0.72	0.73	0.75	0.80	0.82	0.84	1.42
Equatorial Guinea	0.23	0.25	0.29	0.22	0.37	0.52	0.70	0.70	0.90	1.18	1.46
Bhutan	0.17	0.23	0.30	0.43	0.56	0.57	0.73	0.70	0.77	0.83	1.16
Solomon Islands	0.09	0.12	0.16	0.23	0.31	0.41	0.54	0.60	0.72	0.87	0.66
China, Macao SAR	0.20	0.17	0.25	0.25	0.36	0.43	0.54	0.60	0.69	0.78	0.83
Montenegro	0.40	0.47	0.52	0.58	0.61	0.63	0.63	0.60	0.60	0.60	0.91
Western Sahara	0.01	0.03	0.08	0.15	0.22	0.32	0.53	0.50	0.66	0.88	1.13
Luxembourg	0.30	0.31	0.34	0.36	0.38	0.44	0.51	0.50	0.55	0.60	0.59
Cape Verde	0.18	0.21	0.27	0.30	0.35	0.44	0.50	0.50	0.54	0.58	0.61
Suriname	0.21	0.29	0.37	0.37	0.41	0.47	0.52	0.50	0.53	0.56	0.57
Guadeloupe	0.21	0.28	0.32	0.33	0.39	0.43	0.46	0.50	0.52	0.53	0.53
Brunei Darussalam	0.05	0.08	0.13	0.19	0.25	0.33	0.40	0.40	0.45	0.50	0.42
Malta	0.31	0.31	0.30	0.33	0.37	0.40	0.42	0.40	0.41	0.41	0.39
Martinique	0.22	0.28	0.33	0.33	0.36	0.39	0.41	0.40	0.41	0.41	0.54
Maldives	0.07	0.09	0.12	0.16	0.22	0.27	0.32	0.30	0.33	0.35	0.40
Belize	0.07	0.09	0.12	0.14	0.19	0.25	0.31	0.30	0.35	0.40	0.38
Iceland	0.14	0.18	0.20	0.23	0.25	0.28	0.32	0.32	0.35	0.38	0.38
The Bahamas	0.08	0.11	0.17	0.21	0.26	0.30	0.34	0.32	0.35	0.37	0.43
Barbados	0.21	0.23	0.24	0.25	0.26	0.27	0.27	0.27	0.28	0.28	0.28
French Polynesia	0.06	0.08	0.11	0.15	0.20	0.24	0.27	0.27	0.30	0.31	0.32
New Caledonia	0.06	0.08	0.11	0.14	0.17	0.21	0.25	0.25	0.28	0.31	0.32
Vanuatu	0.05	0.06	0.09	0.12	0.15	0.19	0.24	0.25	0.30	0.36	0.41
French Guiana	0.03	0.03	0.05	0.07	0.12	0.16	0.23	0.24	0.29	0.35	0.40
Mayotte	0.02	0.02	0.04	0.06	0.09	0.15	0.20	0.21	0.28	0.38	0.49
Netherlands Antilles	0.11	0.13	0.16	0.17	0.19	0.18	0.20	0.20	0.21	0.21	0.21
Samoa	0.08	0.11	0.14	0.16	0.16	0.18	0.18	0.18	0.19	0.20	0.21
Guam	0.06	0.07	0.09	0.11	0.13	0.16	0.18	0.18	0.20	0.22	0.23
St. Lucia	0.08	0.09	0.10	0.12	0.14	0.16	0.17	0.18	0.19	0.20	0.20
Channel Islands	0.10	0.11	0.12	0.13	0.14	0.15	0.15	0.15	0.16	0.16	0.16
Micronesia (Fed. States of)	0.03	0.04	0.06	0.07	0.10	0.11	0.11	0.11	0.12	0.13	0.13
St. Vincent and the Grenadines	0.07	0.08	0.09	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.11
United States Virgin Islands	0.03	0.03	0.06	0.10	0.10	0.11	0.11	0.11	0.11	0.10	0.10
Aruba	0.04	0.05	0.06	0.06	0.06	0.09	0.11	0.11	0.11	0.11	0.11
Grenada	0.08	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.11	0.11	0.10
Tonga	0.05	0.06	0.08	0.09	0.10	0.10	0.10	0.10	0.11	0.12	0.13

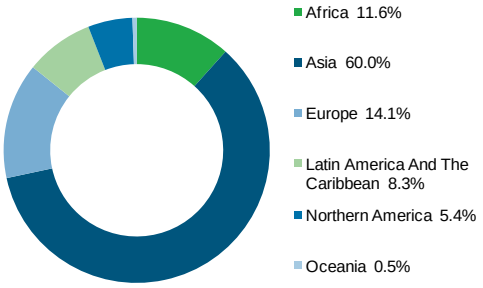
Source: UN data, Standard Chartered Research estimates

Fig 91: Population guide by decade, 1950–2040, (cont'd)

millions	1950	1960	1970	1980	1990	2000	2010	2012E	2020E	2030E	2040E
Kiribati	0.03	0.03	0.04	0.05	0.07	0.08	0.10	0.10	0.11	0.13	0.14
Antigua and Barbuda	0.05	0.05	0.07	0.07	0.06	0.08	0.09	0.09	0.10	0.10	0.11
Seychelles	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.09	0.09	0.09	0.09
Andorra	0.01	0.01	0.02	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.12
Isle of Man	0.06	0.05	0.06	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.09
American Samoa	0.02	0.02	0.03	0.03	0.05	0.06	0.07	0.07	0.08	0.09	0.10
Dominica	0.05	0.06	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Bermuda	0.04	0.04	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07
Northern Mariana Islands	0.01	0.01	0.01	0.02	0.04	0.07	0.06	0.06	0.07	0.07	0.08
Greenland	0.02	0.03	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.05	0.05
Cayman Islands	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.06	0.06	0.06	0.06
Marshall Islands	0.01	0.01	0.02	0.03	0.05	0.05	0.05	0.05	0.06	0.07	0.07
St. Kitts and Nevis	0.05	0.05	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.07
Turks and Caicos Islands	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.04	0.04	0.04	0.05
Faeroe Islands	-	-	-	-	-	-	-	0.04	-	-	-
Liechtenstein	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Monaco	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
San Marino	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Gibraltar	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
British Virgin Islands	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Palau	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Cook Islands	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Anguilla	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Wallis and Futuna Islands	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nauru	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Tuvalu	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Saint Pierre and Miquelon	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Montserrat	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
Saint Helena	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Falkland Islands (Malvinas)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Niue	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tokelau	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Holy See	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2,532**	**3,038**	**3,696**	**4,453**	**5,306**	**6,123**	**6,946**	**7,164**	**8,000**	**8,995**	**10,006**

Source: UN data, Standard Chartered Research estimates

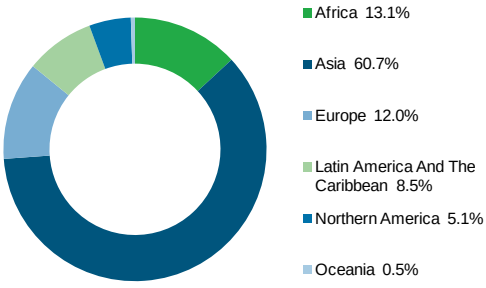
Fig 92: Population by continent, 1987



Legend: segments listed clockwise from top

Source: UN data

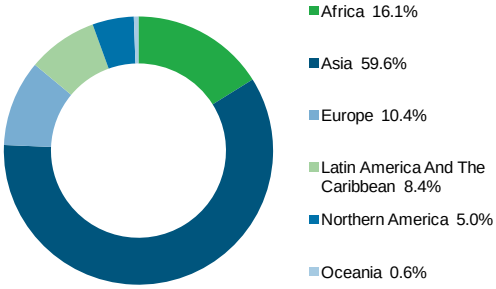
Fig 93: Population by continent, 1999



Legend: segments listed clockwise from top

Source : UN Data

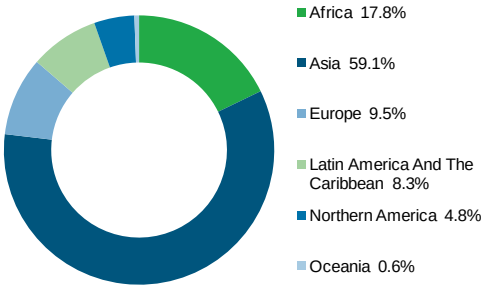
Fig 94: Population by continent, 2012E



Legend: segments listed clockwise from top

Source: Standard Chartered Research estimates

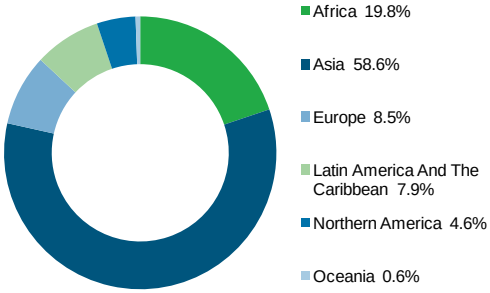
Fig 95: Population by continent, 2020E



Legend: segments listed clockwise from top

Source: Standard Chartered Research estimates

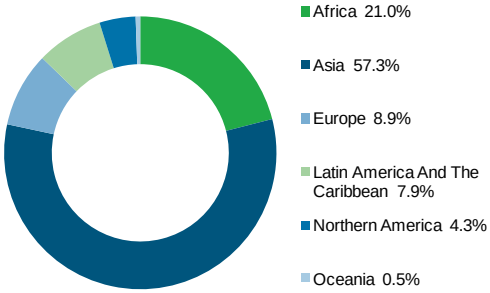
Fig 96: Population by continent, 2030E



Legend: segments listed clockwise from top

Source: Standard Chartered Research estimates

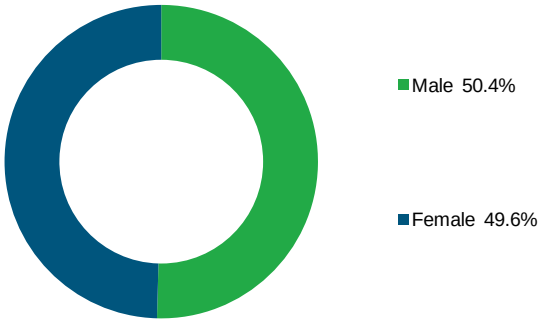
Fig 97: Population by continent, 2040E



Legend: segments listed clockwise from top

Source: Standard Chartered Research estimates

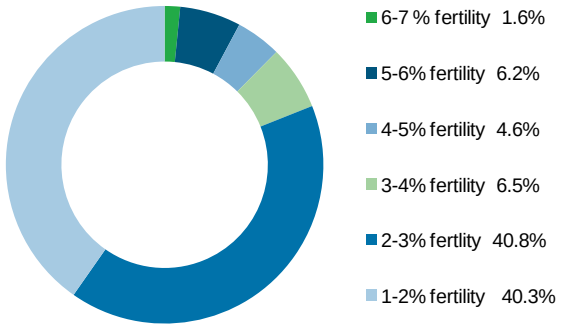
Fig 98: Population by gender, 2012E



Legend: segments listed clockwise from top

Source: UN data, Standard Chartered Research estimates

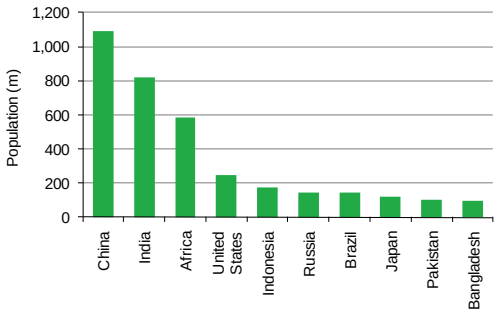
Fig 99: Population by fertility, 2012E



Legend: segments listed clockwise from top

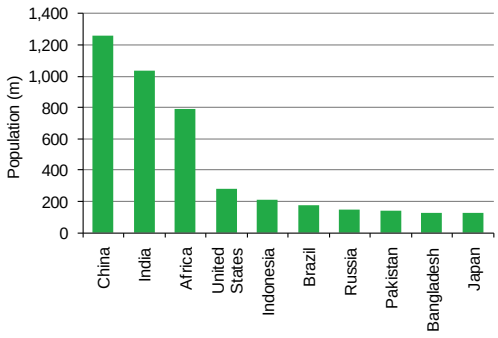
Source: UN data, Standard Chartered Research estimates

Fig 100: Population by region, 1987



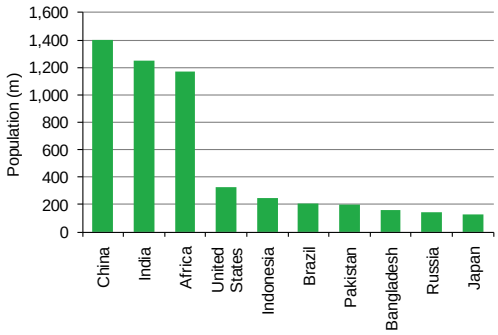
Source: UN Data

Fig 101: Population by region, 1999



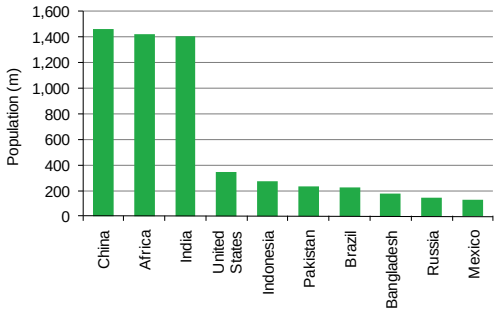
Source: UN Data

Fig 102: Population by region, 2012E



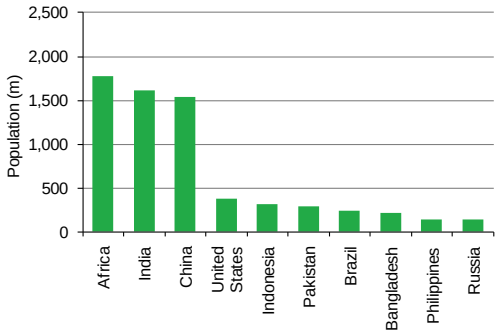
Source : Standard Chartered Research estimates

Fig 103: Population by region, 2020E



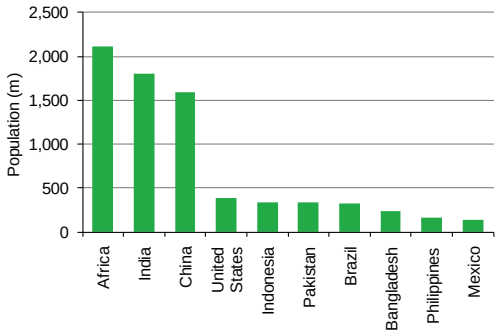
Source: Standard Chartered Research estimates

Fig 104: Population by region, 2030E



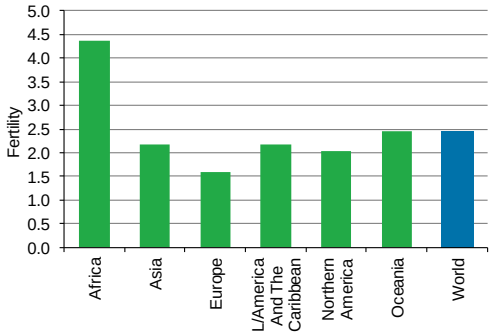
Source: Standard Chartered Research estimates

Fig 105: Population by region, 2040E



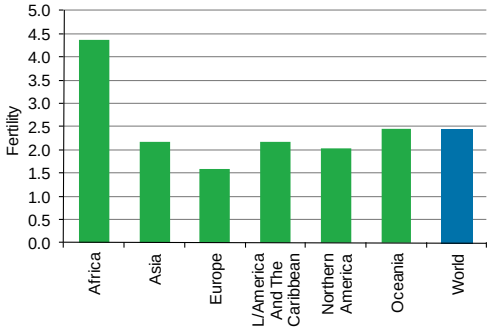
Source : Standard Chartered Research estimates

Fig 106: Fertility by continent, 1987



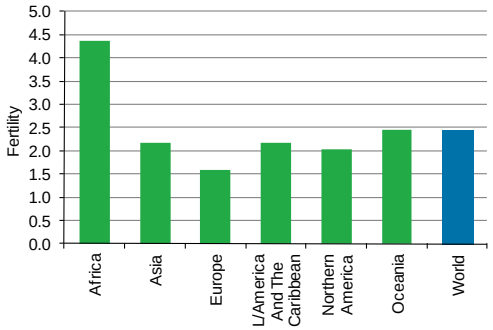
Source : UN Data

Fig 107: Fertility by continent, 1999



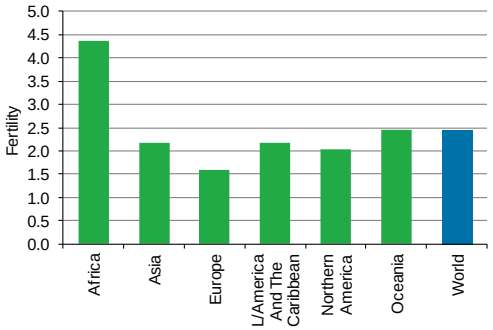
Source : UN Data

Fig 108: Fertility by continent, 2012E



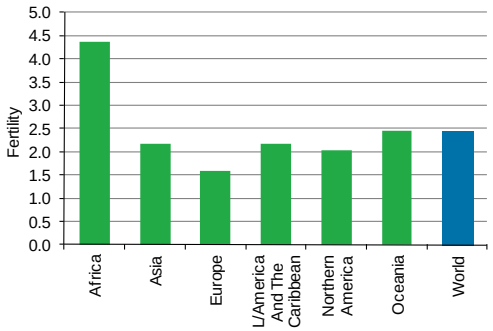
Source : Standard Chartered Research estimates

Fig 109: Fertility by continent, 2020E



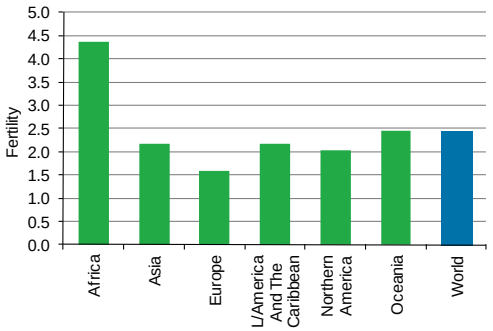
Source: Standard Chartered Research estimates

Fig 110: Fertility by continent, 2030E



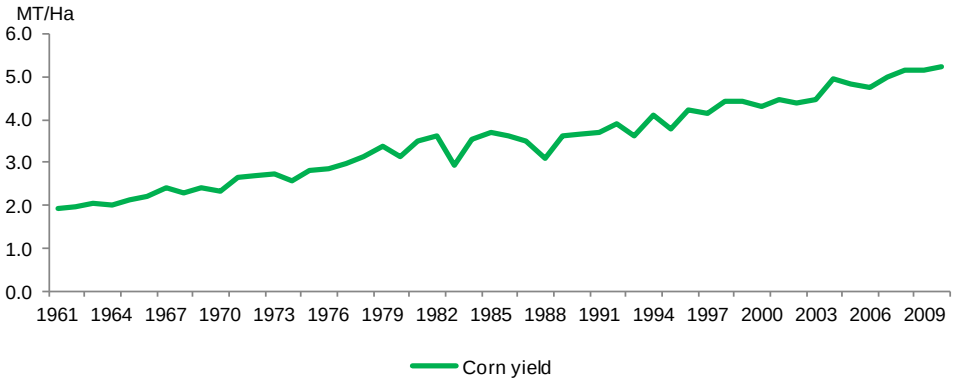
Source : Standard Chartered Research estimates

Fig 111: Fertility by continent, 2040E



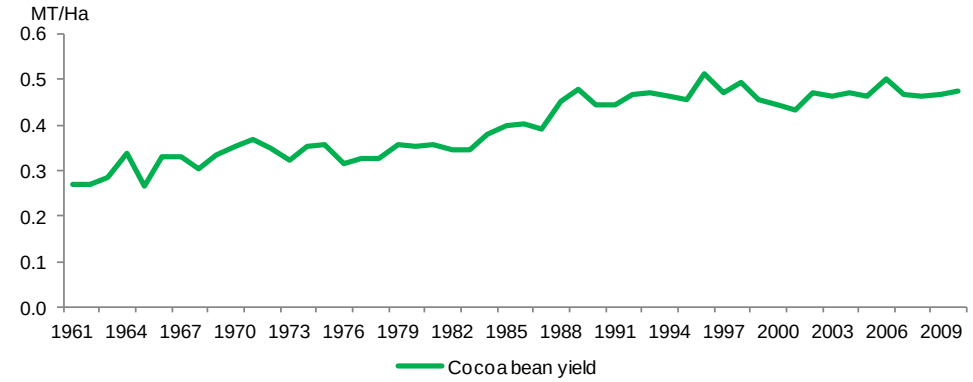
Source: Standard Chartered Research estimates

Fig 112: Corn yield, 1961–2010



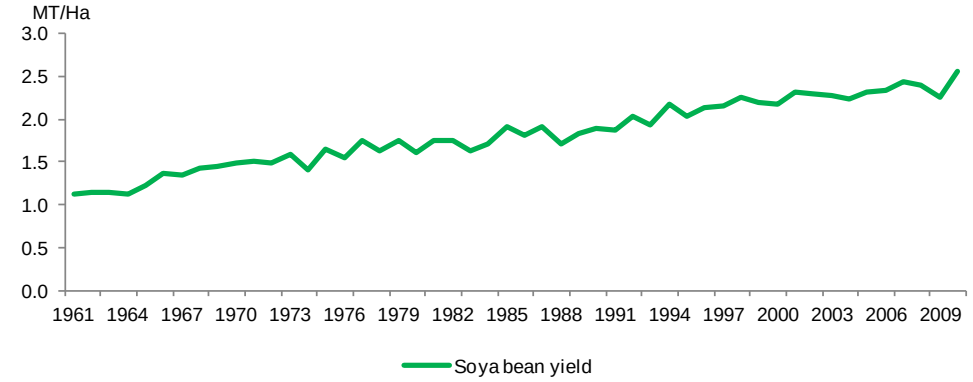
Source: FAO, Standard Chartered Research estimates

Fig 113: Cocoa bean yield, 1961–2010



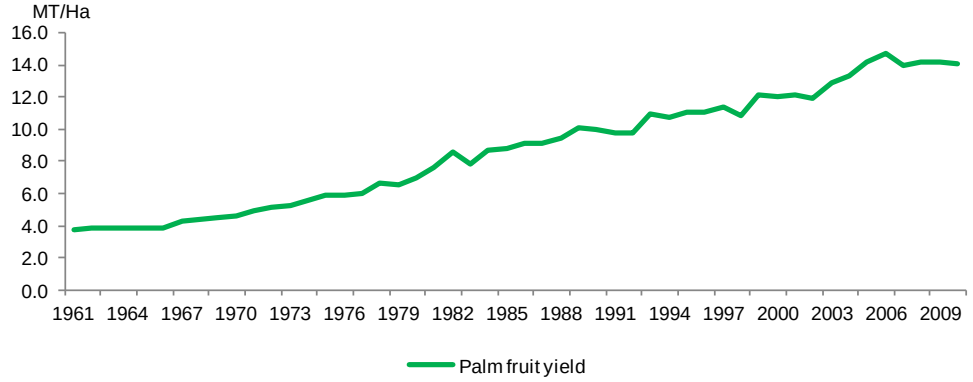
Source: FAO, Standard Chartered Research estimates

Fig 114: Soybean yield, 1961– 2010



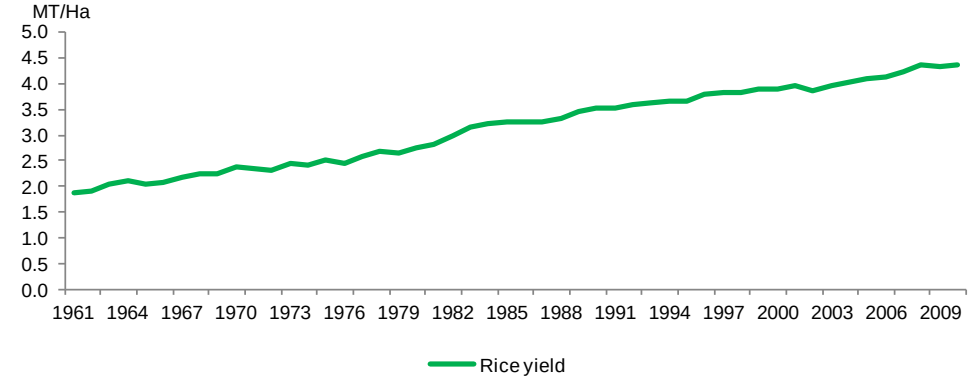
Source: FAO, Standard Chartered Research estimates

Fig 115: Palm fruit yield, 1961–2010



Source: FAO, Standard Chartered Research estimates

Fig 116: Rice yield, 1961–2010



Source: FAO, Standard Chartered Research estimates

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As of 30 June 2012

Research Recommendation

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