The Food Report – The end of cheap food

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Important disclosures can be found in the Disclosures Appendix

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Introduction

As the 21st century progresses, the world faces the increasing challenge of raising living standards for a growing number of people. In our view, this challenge is felt most acutely in the issue of providing sufficient quantities of three related resources: water, food, and energy. To add to the challenge, climate change is impacting the environment at the same time at which we are trying to tackle these resource issues.

To solve this triple resource issue, we need to balance the water-food-energy nexus. This coming together of the issues was perfectly illustrated with last year's rapid rise in food prices. Biofuel demand rose on the back of higher oil prices, which in turn diverted much of the water used in agricultural production to ultimately providing energy rather than food. Solving this resource exchange in an efficient way will be vital to the long-term resolution of resource issues.

Standard Chartered Bank operates in many of the markets most intimately involved in this challenge: big resource producers, the biggest resource consumers, those with the largest and fastest-growing populations and most dynamic and rapidly growing economies, and, lastly, those likely to be most impacted by climate change. Thus, to gain a better understanding of the medium- to long-term outlook, we believe it is essential to focus on our core markets of Asia, Africa, and the Middle East.

The negative impact of rising demand, whether for food or other resources, will have a number of solutions. These can be seen in terms of price, output, or technology – or, more likely, all three. We could see rising prices, increased output, countries earmarking output for domestic use, and a greater focus on new technological solutions. Last year, when food and energy prices soared, a number of issues were identified. Not least among these was the need to deter speculative activity which drives up the prices of commodities crucial to everyday life. That still needs to be addressed. The attraction of commodities as an investment class became more widely recognised.

Furthermore, the rapid price increase highlighted the need for increased investment not only in new technology, but also in countries rich in resources or with high potential to increase food output. The financial crisis may have temporarily delayed investment flows, but in coming years, a number of countries are well-positioned to attract inward investment and increase their food production, both for domestic consumption and for international trade.

On World Water Day, March 20, 2009, we published 'Water: the real liquidity crisis', providing an analysis of the issue of water resources – in particular how they impact Asia, Africa, and the Middle East, and our views on possible investment opportunities. Today, on World Food Day, we turn our attention to the next resource issue: food, and in particular, the impact on Asia, Africa, and the Middle East. We hope you find our team's analysis and views both interesting and useful.

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Executive summary: the end of cheap food

Global solutions, regional disparities, local problems

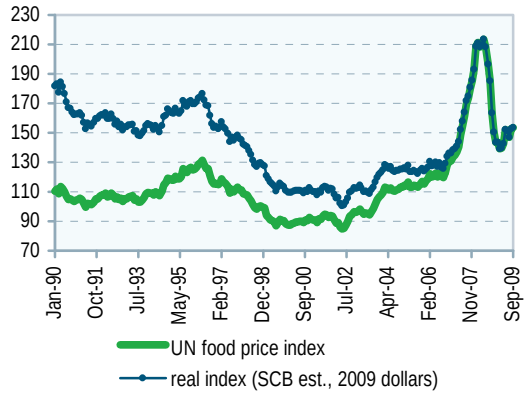
While food prices are lower now than in mid-2008, they remain at historically high levels (Charts 1 and 2). Prices are now rising again and are 80% higher than the recent low in mid-2002. In our view, this marks the resumption of a longer-term trend of rising prices, driven by the increasing cost of agricultural production to meet the inexorable rise in demand for food commodities.

In this report, we look at the elements driving longer-term demand growth and the constraints to supply growth – including shortage of land, decelerating yield growth, competition from biofuels, water scarcity, and, last but not least, climate change, which, at a minimum, will likely make weather conditions even less predictable than they are today.

We draw the following conclusions:

1) 'Feeding the world' is achievable at a global level, but at a cost which will inevitably mean higher prices.
2) Regional variations in food availability will widen, leading to more cross-border investment in the agricultural sector, the risk of protectionist policies, and heightened food security concerns for net food importers.
3) At a local level, food affordability will become a key focus of fiscal and trade policy across the developing countries. While higher prices have positive implications for farm incomes and investment incentives, they will hinder the drive to improve food security for the poor.

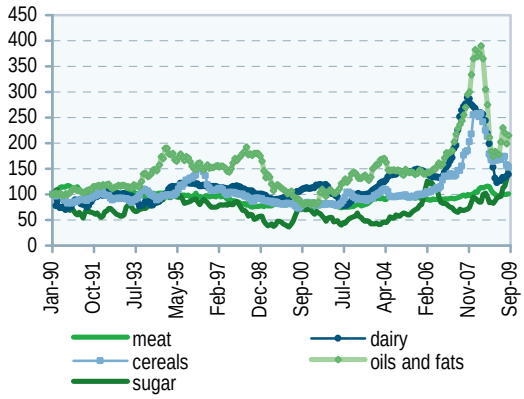
Chart 1: UN food price index



Sources: UN FAO, SCB Global Research

Chart 2: Food price indices by category

(rebased, Jan-1990=100)



Sources: UN FAO, SCB Global Research

Roots of the 2008 food price highs

Prices rose to highs in 2008 for both cyclical and structural reasons. Grain harvests were relatively poor for a number of years prior to the crisis, mostly due to adverse weather conditions, which led to a tightening of stock levels. The situation was exacerbated by an acceleration in demand from the biofuel sector, which boosted demand for agricultural commodities such as corn, sugar, and edible oils. Higher feed costs then fed through to the livestock sector.

Critically, costs also rose, driven by higher energy prices. Investor interest in commodity markets was also intense, adding to upward pressure on asset prices. Policy responses, while relieving local pressures, in some cases added to the lack of exportable supply and drove internationally traded prices even higher. Financial-market influences were also important – abundant liquidity and investor interest in commodity markets generally supported prices at higher levels. A weaker USD was also a key factor.

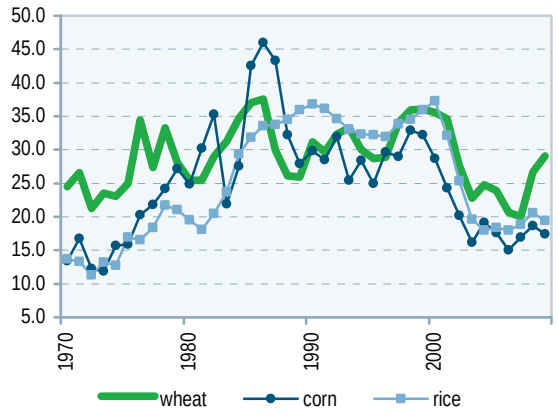
The combination of the global economic recession and improved supply conditions has helped to bring prices lower. However, the underlying tension of constant pressure to expand output to meet growing demand over the longer term has not disappeared.

Good availability near-term, but vulnerabilities remain

In the short run, as demand is growing relatively slowly, supply is generally the issue. This year, supply of food commodities has improved due to a strong supply response from developed regions (as a result of high prices in 2008) and due to generally more favourable weather conditions. Soybeans and sugar are the possible exceptions, with poor weather conditions affecting crops in Latin America and India, respectively. However, supply of grains, which dominate food consumption, has either stabilised or risen. As Charts 3 and 4 show, stock-to-use ratios (stocks as a percentage of annual demand) are higher than they were two years ago.

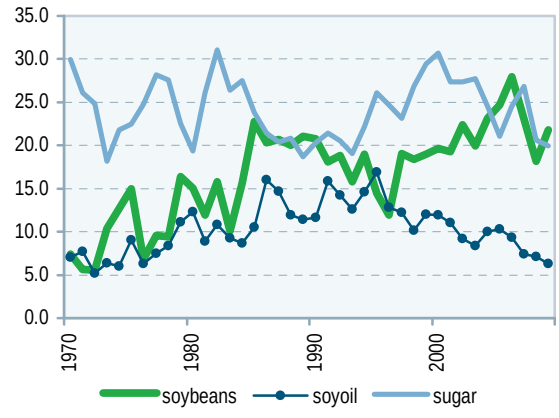
However, the charts also show that stocks as a proportion of demand have dipped substantially over the past five years, leaving the markets much more vulnerable to supply shocks in the short term. Some of this is weather-related, but much is due to ongoing pressure to increase supply in the face of rising demand.

Chart 3: Stock-to-use ratios – grains (%)



Sources: USDA, SCB Global Research

Chart 4: Stock-to-use ratios (%)



Sources: USDA, SCB Global Research

Rising demand

Food demand is expected to continue to grow, albeit at a slower rate than in the last couple of decades, and the composition of that demand is changing with rising incomes and urbanisation. If the world population reaches 9.1bn by 2050, this will require a 70% increase in food production from 2005-07 levels, including a 900mn tonne (43%) increase in cereal production and a 200mn tonne (74%) increase in meat production. These projections from the UN include a continued increase in 'average daily calorie availability', improving food availability to the poor.

Constraints to raising agricultural output

Agricultural output will need to rise. In simple terms, this can be achieved by either increasing the acreage planted or improving yields. In Chapter I below, we outline current official UN projections for meeting global food, feed, and fuel demand from the agricultural sector.

While in theory there is sufficient land available for an expansion of arable acreage, competing land uses will likely bid up rents and thus commodity prices. The available land is also unevenly distributed, concentrated in Latin America and Sub-Saharan Africa. The UN assumes a substantial increase in yields (+77%) by 2050 – the same rate of increase seen since 1961. This may be achievable, particularly with the development of agricultural biotechnology and genetic modification techniques, but will require significant investment in the agricultural sector, adding to upward pressure on costs and prices.

Water scarcity and climate change

There are also the more far-reaching issues of water scarcity and climate change, which may even begin to affect existing production levels, let alone plans for expansion.

The agriculture sector is highly water-intensive, but in many areas of the world – particularly in Asia, Africa, and the Middle East – water is an extremely limited resource. Pollution, aquifer depletion, and potentially climate change are adding to the problem. The good news is that the world has sufficient water to meet agricultural and all other needs. But this will require investment and a flexible approach to the use of water, especially for agriculture and particularly where food security is concerned.

The weather continues to be the most important determinant of global agricultural output. Historical weather patterns are already changing. Most climate models predict more rainfall in the northern and southern latitudes and less in the sub-tropics, and greater risk of both droughts and floods. Extreme weather events are also predicted to rise substantially, and longstanding weather patterns (e.g., the monsoon) may change.

All of these factors will affect food production – some positively, many negatively – as weather patterns become less stable. Recent examples are the twin negative impacts on the sugar market from flooding in Brazil and inadequate monsoon rains in India – bringing damage to yields from both too much and too little water. Adaptation will be required to adjust to the new 'abnormal' weather conditions.

Biofuels – intensifying the link with energy prices

Biofuels have become a significant driver of demand for agricultural commodities such as corn, sugar, and palm oil. While there is little possibility that biofuels will solve the global energy problem, and extensive debate over their economic and environmental benefits, we believe that the drive towards energy security will continue to ensure a policy-driven expansion of the sector.

This has two implications. First, barring the development of biofuels using non-food feedstocks, there will be greater competition for arable land than would otherwise be the case. This will put upward pressure on costs and prices. Second, agricultural prices, particularly for biofuel feedstocks, will likely become more correlated with energy prices and risk seeing the same levels of volatility. The impact of speculation on commodity markets is a hotly debated issue that we will not attempt to resolve here, but extended regulation is unlikely to deter this investment. Thus, agricultural markets will continue to see substantial flows and be increasingly affected by macro sentiment and trends.

In this report, we take a more detailed look at particular food issues facing Africa, Asia, and the Middle East.

Africa – time to realise its potential

For Sub-Saharan Africa, we examine prospects for exploiting the region's theoretically available agricultural land. The continent is relatively land-abundant, land utilisation rates are low, and the productivity of land under cultivation could be increased significantly. While a number of factors have weighed on the progress of farming, many of these are starting to be addressed.

Opportunities in agriculture (and, more generally, in higher-value-added agribusiness) in Africa are beginning to attract substantial foreign investor interest. Provided that the policy environment continues to evolve favourably, and that supportive financial conditions develop, agriculture and related downstream activities in Africa look set to grow.

Asia – the swing factor

Due to Asia's vast size, a wide variety of food issues affect different locations within the region. However, due to its huge population, combined with rapid economic growth rates, Asia is far and away the most important influence on global food demand. It is also the world's biggest supplier of food, but because there is little spare land and production is already quite intensive, with good yields, the possibility of dramatic increases in supply may be limited. Add in climate change, environmental damage, and water scarcity, and even maintaining supply may become an issue.

While China and India are to a large degree self-sufficient in food, there is a dramatic impact on the market when crops fail (such as sugar in India this year) or tastes develop for commodities that are not domestically available (such as soybeans in China), due to the sheer scale of the demand relative to traded markets in these products.

MENA – food insecurity

For the Middle East and North Africa (MENA), the key issue is growing dependence on food imports. The outlook is dominated by two factors: water and demographics. MENA is one of the most import-dependent regions with regards to food. This is due to a shortage of water resources, which makes it difficult to grow water-intensive crops like grains, as well as large demand from a young, growing population.

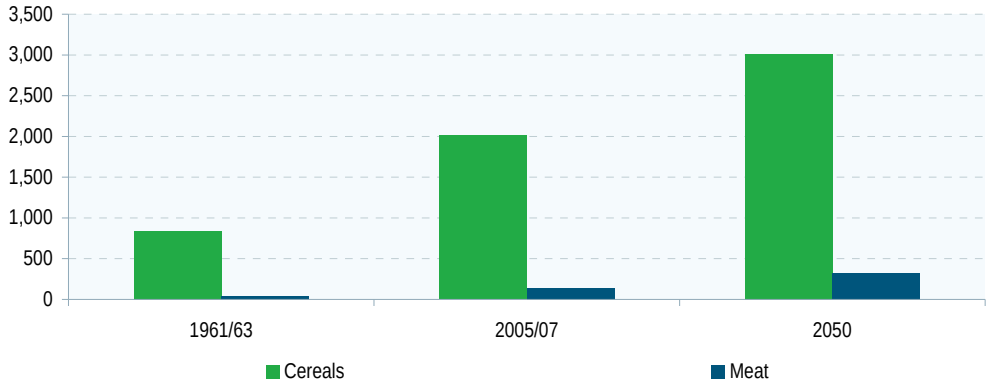
According to USDA estimates, the MENA region will import 71%, 58%, and 39% of its rice, corn, and wheat domestic consumption requirements, respectively, this season. This import dependence makes the region vulnerable to global price fluctuations and to changes in trade policies in exporting countries.

I. Rising demand for food

Food demand is set to rise 70% by 2050

The UN Food and Agriculture Organisation (FAO) estimates that food demand will rise 70% globally by 2050, and double in developing countries. This is a result not only of population growth but also of rising incomes and urbanisation. The projections show that cereal output will need to rise by almost 1bn tonnes (43%) and meat output by over 200mn tonnes (mt) (74%) to 470mt. Meeting the needs of the changing composition and volume of food demand is a key challenge for policy makers and the agricultural sector.

Chart I.1: Projected agricultural production (mn tonnes)



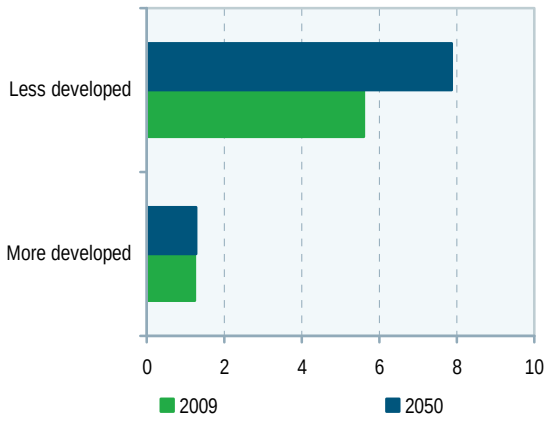
Source: FAO (2009)

Population growth slowing but still significant

World population to rise 35% by 2050

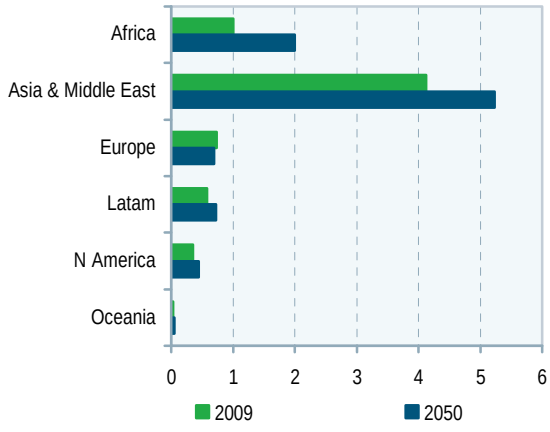
The UN projected earlier this year that the global population to grow by around 35% from the current estimated level of 6.8 billion to 9.1 billion by 2050. While this implies slowing population growth, it nevertheless foresees the addition of around 56mn people per year – similar to the populations of Korea, France, or the UK.

Chart I.2: Forecast population growth (bn)



Source: UN (2009)

Chart I.3: Forecast population growth by region (bn)



Source: UN (2009)

Virtually all of the growth is expected in developing countries, and without migration, the populations of developed regions would likely fall. The fastest growth rates are anticipated in Africa, where the population is expected to rise by almost 1 billion people (98%). Asia's projected growth rate is slower, but its large absolute numbers result in a significant increment. In total, the population of Asia and the Middle East is set to rise by 1.1 billion (27%) by 2050.

Income growth, urbanisation, and dietary convergence

Income growth and urbanisation are driving changes in eating habits

The composition of food demand is also changing, and with it demands on the agricultural sector. Key drivers include income growth, urbanisation, and dietary convergence. Given the changes in global per-capita income and the rise of an affluent middle class in large lower-income economies like India and China, there has been a noticeable shift towards higher-value food items such as edible oils and meat protein. Chart I.4 shows the rise in consumption of food commodities over the past 40 years on a per-capita basis. The growth in oilseeds and meat consumption is a clear reflection of rising incomes.

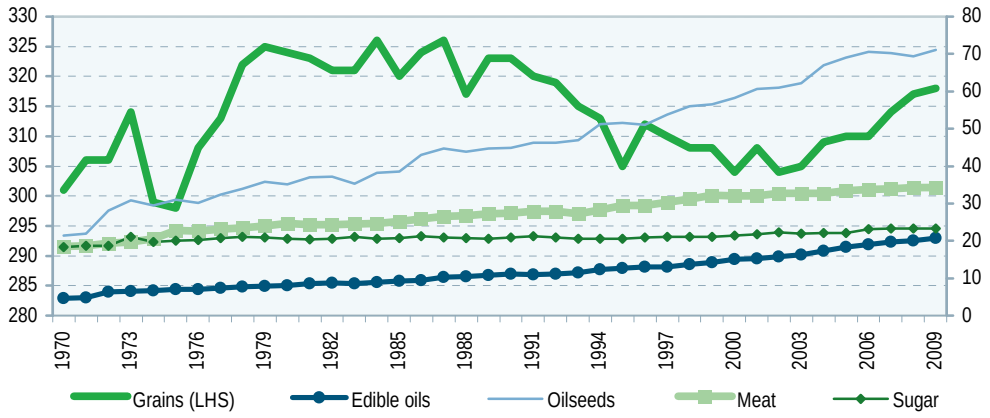
Since diets rich in meats require feed grains and meals, they actually demand more cereal than diets based on direct cereal consumption. In 2000, China's household surveys showed that per-capita red meat consumption in urban areas was 40% higher than in rural areas. Per-capita fish consumption in urban areas was three times higher, and egg and poultry consumption was more than 2.5 times higher than in rural areas. Urban per-capita grain consumption was only one-third the rural average.

Rapid rates of urbanisation are also expected to significantly alter consumers' diets, as urban incomes are higher. By 2050, more than 70% of the global population is expected to be urban, boosting consumption of meats, fruit, vegetables, and processed food products.

Case study – the UAE

The UAE, like some other Gulf countries, is characterised by rapid urbanisation, high population growth (mainly through migration), a young and growing population (Chart 1.6), and rising per-capita incomes. It therefore provides a good case study on how changes in income and demographics can affect food consumption.

Chart I.4: Per-capita consumption of key food commodities (kg/capita)



Sources: USDA, SCB Global Research

Table I.1: Budget shares and income elasticities of food sub-categories

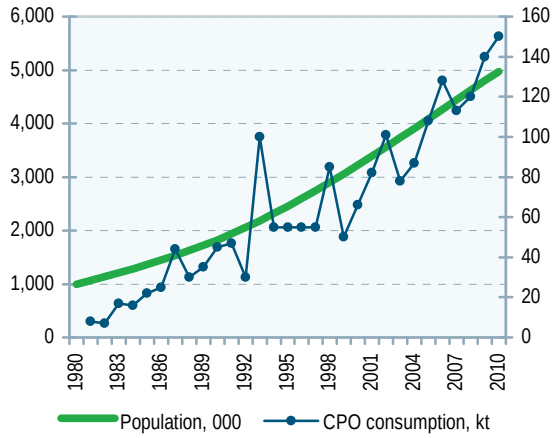
	Share of food budget		Income elasticity	
	Low-income	High-income	Low-income	High-income
Cereals	28%	16%	0.56	0.19
Meat	18%	25%	0.82	0.33
Fish	5%	6%	2.77	0.43
Dairy	9%	14%	0.93	0.35
Oils and fats	7%	4%	0.58	0.21
Fruits/vegetables	23%	15%	0.80	0.32
Other food	11%	15%	0.80	0.32

Source: USDA, based on 32 low-income and 26 high-income countries

Since 1975, the demographic structure of the UAE has undergone large-scale changes. According to research by the Emirates Centre for Strategic Studies and Research (ECSSR), the country's population growth rate rose to 15% between 1975 and 1985 from 1% in the prior decade, mainly as a result of a strong inflow of economic migrants. It is estimated that indigenous residents, who accounted for over 60% of the total population in 1968, comprised less than 20% by 1985. Their share is currently estimated at 15%, based on the latest census. The UAE is almost entirely made up of urban areas, with the majority of the population living in the cities.

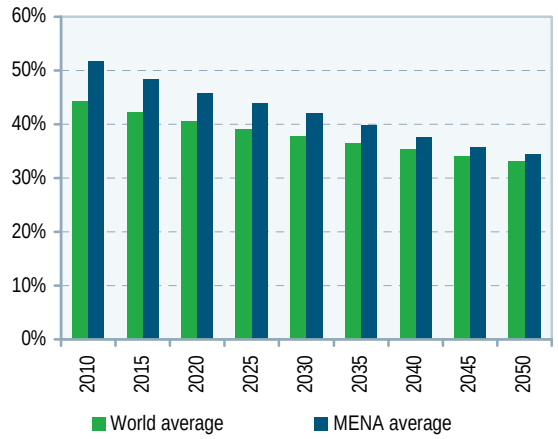
This change in the population structure has had a tangible effect on the variety and volume of food consumed in the UAE. Overall, the country's diet and food imports now reflect Western and South Asian preferences rather than traditional Arab preferences. While traditional Arab diets include cereals and dairy, meat (especially poultry) is by far the most important element.

Chart I.5: Growth in palm oil consumption has coincided with rapid population growth in the UAE



Sources: UN, USDA, SCB Global Research

Chart I.6: Average population under 25, world vs. MENA



Sources: UN, SCB Global Research

Data from the USDA underpins the fact that consumption of non-traditional foodstuffs has increased. For instance, rice consumption in the UAE has risen from 14,000 tonnes (t) in 1970 to around 300,000t in 2009, largely reflecting South Asian and Western eating habits. Similarly, palm oil use has increased, with consumption rising

from 8,000t in 1980 to around 375,000t in 2009. Palm oil is a key component of Asian diets – Indonesia and Malaysia are the largest producers, and China and India the top two consumers and importers. The presence of a large expatriate population from South Asia has encouraged imports of edible oils to the UAE.

Overall, the composition and growth of the UAE population is leading to increasing reliance on food imports.

II. Increasing agricultural output

Increasing agricultural output is possible, but at a higher cost

Can the agricultural sector cope with increased demand for food commodities? We argue that it can, but that significant headwinds are likely to lead to higher costs and, inevitably, prices. Moreover, while sufficient food can be generated at a global level from the resources available, it will not necessarily be generated in the right places. Food availability will vary widely between countries, and food security will be a significant issue for regions which are reliant on food imports.

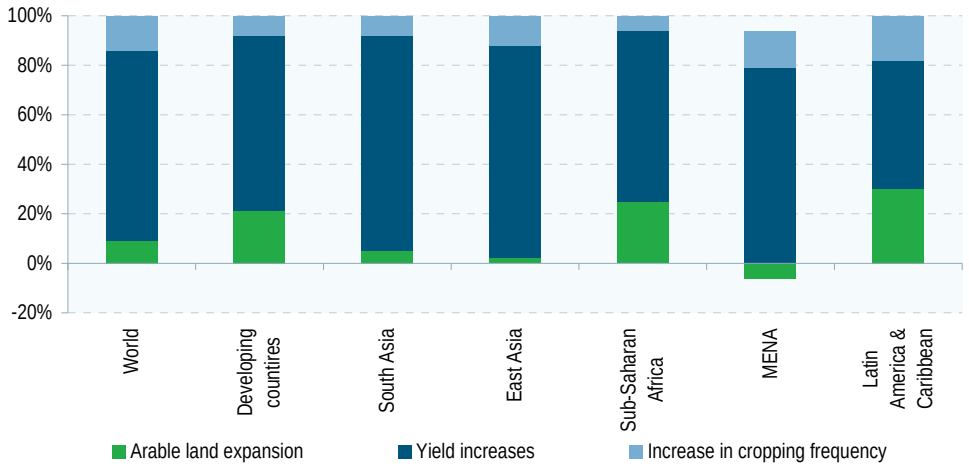
Affordability will also be an issue as prices rise. It is misleading to focus purely on the need to increase supply. If, as we conclude in this report, prices will need to rise to ensure adequate supply, localised food insecurity will be a key issue in the poorest parts of the world.

Land and yields

There are three ways of increasing agricultural output – by expanding acreage, improving yields, or increasing the frequency of cropping. Of these factors, improving yields has been the most important over the last 50 years, accounting for 75% of the increase in output. However, studies suggest that yield growth rates are now slowing.

Current projections that agricultural output gains are achievable assume a significant increase in yield over the forecast period.

Chart II.1: Sources of growth in crop production to 2050 (%)

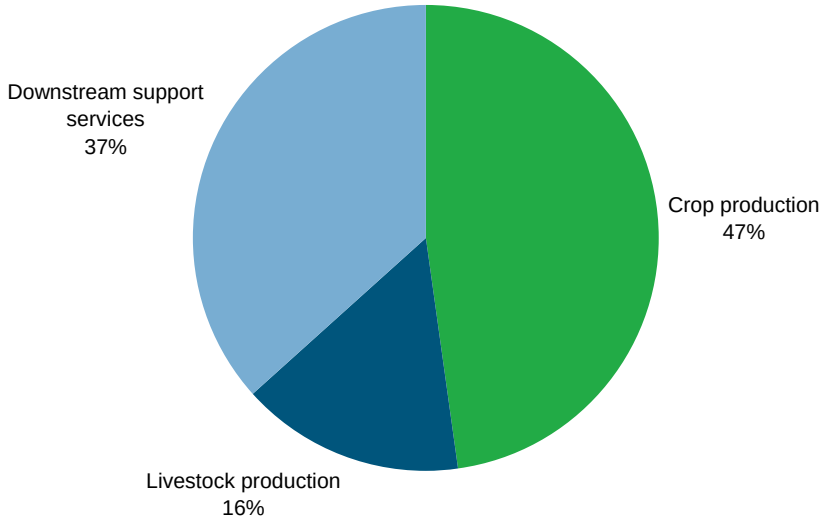


Source: FAO (2009)

In developing countries, almost 80% of the increase in output is expected to be generated by intensification rather than increases in arable land – 71ppt from higher yields and 8ppt from increased cropping frequency (multiple cropping or shortened fallow periods). For Sub-Saharan Africa, higher yields account for 69% of the projected increase; this proportion rises substantially for East Asia (98%), South Asia (95%), and MENA (107%), where land is scarcer.

Yield growth has been decelerating, largely due to a corresponding deceleration in agricultural investment, which is in turn a function of low prices. The level of improvement in yields now required will only be possible with substantial research and development. A study by the FAO suggests that USD 9.7trn needs to be invested by 2050 (Chart II.2).

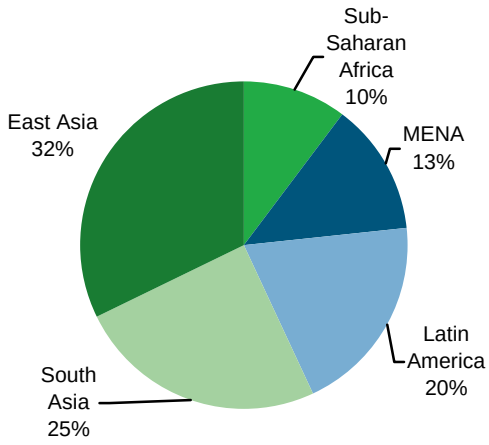
Chart II.2: Investment required in agricultural sector to 2050



Source: FAO (2009)

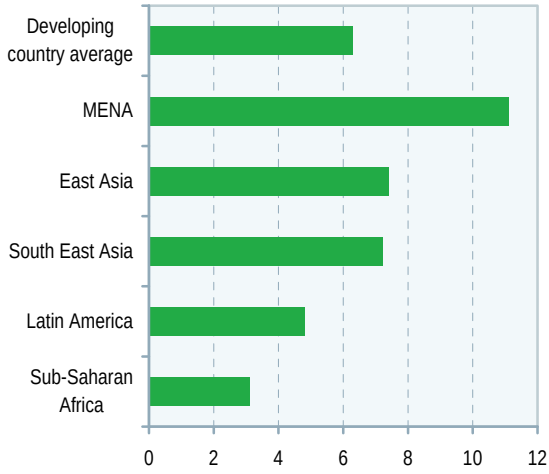
Chart II.3 below shows the breakdown of projected investment by region. Potential returns on investment are higher in Sub-Saharan Africa, given the region's high potential and the lack of investment to date (see Chart II.4 on incremental capital output ratios). However, investment is likely to be greater in Asia due its large agricultural base, high output, and relatively capital-intensive production techniques.

Chart II.3: Projected investment by region



Source: FAO (2009)

Chart II.4: Incremental capital output ratios (ICOR)



Source: FAO (2009)

If this investment is not forthcoming, more pressure will be put on land resources, which are competing with other land uses. Estimates from a joint FAO/IIASA study titled

Limited additional arable land is available

'Global Agro-Ecological Zones' suggest that a total of 4.3bn hectares (ha) of land worldwide is suitable for rain-fed agriculture, of which only 1.6bn are currently cultivated. While the land is suitable in theory, it is competing with other land uses, such as urban areas or the provision of crops for biofuels, or it may even be forested.

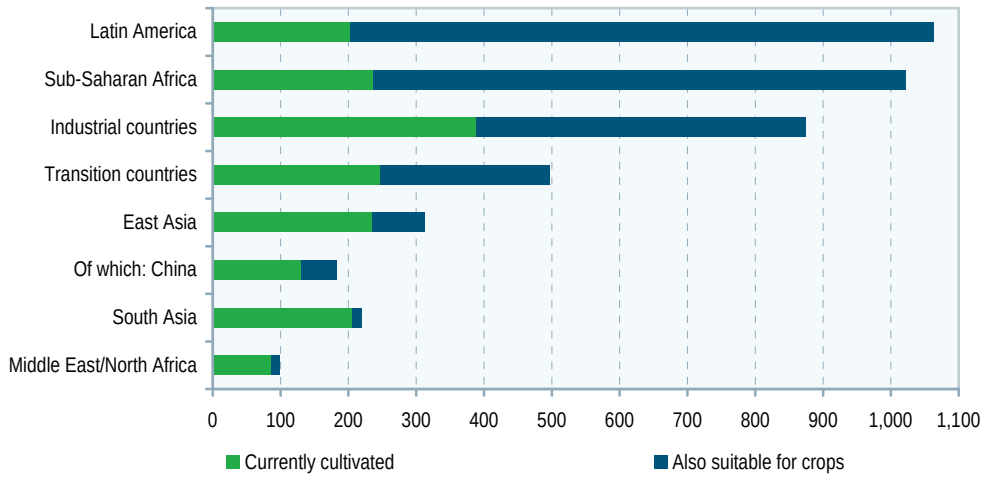
FAO projections to 2050 suggest an increase in arable land of just 70mn ha over the period (comprising a 120mn ha expansion in developing countries and a 50mn ha contraction in developed countries). This is a relatively small increase, well within the measures of land potentially available. However, as we discuss above, this is critically dependent on sufficient investment to achieve significant yield increases.

Of even more concern is the distribution of the available land. As Chart II.5 shows, the theoretically suitable land is predominantly located in Latin America, Sub-Saharan Africa, and Industrial countries. The Middle East and Asia are relatively less endowed, and in some countries, current output has been pushed beyond the limits of rain-fed agriculture with the use of extensive irrigation This raises the issue of water availability, which we address later in this report.

The conclusion we draw from this is that particular regions of the world will become increasingly reliant on imports for food. The Middle East and North Africa have already reached that point, while Asia is currently pushing the limits and is likely to become increasingly import-reliant in the future.

Sub-Saharan African and Latin America are well placed in theory to increase output, and the drive towards cross-border investment in agricultural land, highlighted in Chapter V on Africa, is likely to intensify.

Chart II.5: Available land for rain-fed crop production



Source: FAO (2009)

The Black Sea region

The Black Sea region – including Ukraine, Kazakhstan, and Russia – has bucked the trend of declining agricultural productivity and could help to provide a near-term solution to declining global stocks, given its relatively price-competitive and fertile land and its favourable location at the crossroads between Asia and Europe. Since 2000, the combined share of world trade in agricultural products of Russia, Ukraine, and Kazakhstan has grown from 6% to 24%. These countries have taken market share from major exporters including the US, Canada, and Australia, whose shares contracted to 20%, 14%, and 10%, respectively, in the 2008/09 season from 29%, 17%, and 16%, respectively, in the 200/01 season.

Ukraine, which has seen sustained growth in its agricultural business in the past decade, has recently pushed itself to the top of the food supply chain. The country holds 40% of the world's black soil, which is more fertile and more workable than any other soil type and is considered a precious commodity in agriculture. Moreover, farmland in Ukraine is relatively affordable, with land prices at around USD 1,500 per ha in 2008, compared to USD 4,400-7,800 in Argentina and USD 4,500-28,000 in the US.

Yet massive new investment in agriculture is required in the region, by both the public and private sectors. The use of land currently under cultivation will also need to be intensified by increasing input utilisation and introducing new crop varieties. As in Africa, there is a deep need for infrastructure development to provide a more solid framework on which to build production and grain-exporting capability. This includes a good road, rail, and sea transport network, which can reduce the cost of moving crops and thus increase supply distribution globally. While it is premature to be too optimistic about prospects for the Black Sea region, the region is likely to maintain its role as a medium-sized grain exporter in the future.

Biotechnology and genetic modification

Yield growth will depend heavily on biotechnology and genetic modification

Agricultural biotechnology (BT) and genetic modification (GM) are potentially part of the solution in terms of both increasing yields and improving their reliability.

BT and GM are a collection of scientific techniques used to create, improve, or modify traits of plants, animals, and micro-organisms. Crops with enhanced input traits, such as pest resistance, herbicide tolerance, and tolerance to environmental stresses (such as drought), represent the first generation of GM. Second-generation crops include those with added-value output traits, such as nutrient enhancement for animal feed. The third generation of GM crops, which, like the second generation, is still at various stages of research, includes crops that produce pharmaceuticals or improve the processing of bio-based fuels, and products beyond traditional food and fibres.

Genetically modified, or GM, crops first became commercially available in the mid-1990s and have gained ground globally among agricultural mainstays like corn, soybeans, and cotton, especially in the US. The adoption of these varieties has been driven by potential cost savings, including reduced input use.

Advantages of GM crops

The overriding reason for the adoption of GM techniques is to improve yield. GM crops also enable processors to improve the quality and content of animal feed, food, and energy sources; consumer benefits include increased protein, healthier oils, or carbohydrate enhancements. Furthermore, survey data from the USDA indicates that the adoption of herbicide tolerant (HT) soybeans appears to be associated with tillage conservation, which reduces soil erosion by wind and water, increases water retention, and reduces soil degradation and water and chemical runoff. Thus, adoption of HT crops may indirectly benefit the environment by encouraging farmers to use soil conservation practices.

USDA figures indicate that approximately 91% of US soybeans, 88% of US cotton, and 85% of US corn planted in 2009 has been genetically modified. Farmers favour modifications that allow them to get more out of each seed, resulting in the potential for higher yield and better pest and weed control throughout the planting season. These techniques help farmers, especially small-scale growers, conserve time and inputs. In corn, for example, marketers have promoted High Fermentable Corn (HFC) hybrids selected for their strong agronomic characteristics and high ethanol yield.

In Asia and Africa, net food-importing countries like the Philippines, Burkina Faso, and Senegal have made strides in GM crops in a bid to reduce their import requirements or, in the case of Burkina Faso, to increase crop resistance to drought, which is typical in Africa's semi-arid region.

Concerns, bottlenecks, and policy recommendations

Not all countries have made rapid progress in adopting GM crops. Notably, as of April 2009, the European Union had approved only 10 of 68 GM crop applications for use in the EU (mainly herbicide-tolerant corn, rapeseed, and soybeans), due in part due to regulatory bottlenecks. The EU seeks to balance the need to protect human and animal health, the environment, and consumer interests.

Consumer perceptions of and attitudes towards GM crops vary within and across regions. The key health fear is that modified genes can spread from GM crops to other, natural species of plants through cross-pollination, and that they can even move into animals and humans.

Overall, we believe that the importance of GM crops will grow along with pressure to improve yields globally, and adoption appears to be growing as food security concerns rise. GM crop adoption is likely to be most successful in the biofuel industry as a way of meeting demand for feedstocks. Technological advances, such as engineering plants to be genetically incompatible with local wild plants, should help to overcome resistance.

III. Biofuels – food security vs. energy security

Energy security is likely to compete with food production

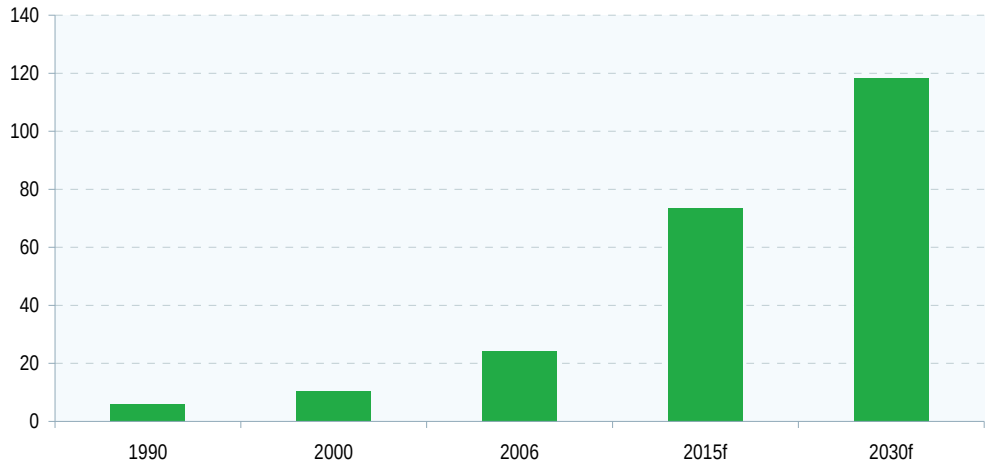
Demand for biofuel feedstock is one of the factors that has caused food commodity prices to rise. Ambitious plans to expand biofuel capacity have been scaled back as concerns about the impact on food security and the environment have intensified. However, the drive for energy security is likely to maintain sufficient momentum to keep government mandates in place and increase biofuel consumption, regardless of profitability.

This has two implications. First, the competition for acreage will inevitably lead to higher food prices than would otherwise have been the case. Second, food and energy prices will become increasingly interdependent, with food commodity prices potentially becoming as volatile as energy commodity prices.

Biofuels – ambitious expansion plans

Demand for liquid biofuels (ethanol and biodiesel) has grown sharply in recent years in response to higher energy prices. In absolute terms, consumption has risen from 10.3 million tonnes of oil equivalent (mtoe) in 2000 to 24.4mtoe in 2006. US demand rose by 23.3% p.a on average between 2000 and 2006, and the US overtook Brazil as the largest consumer of biofuels in 2004.

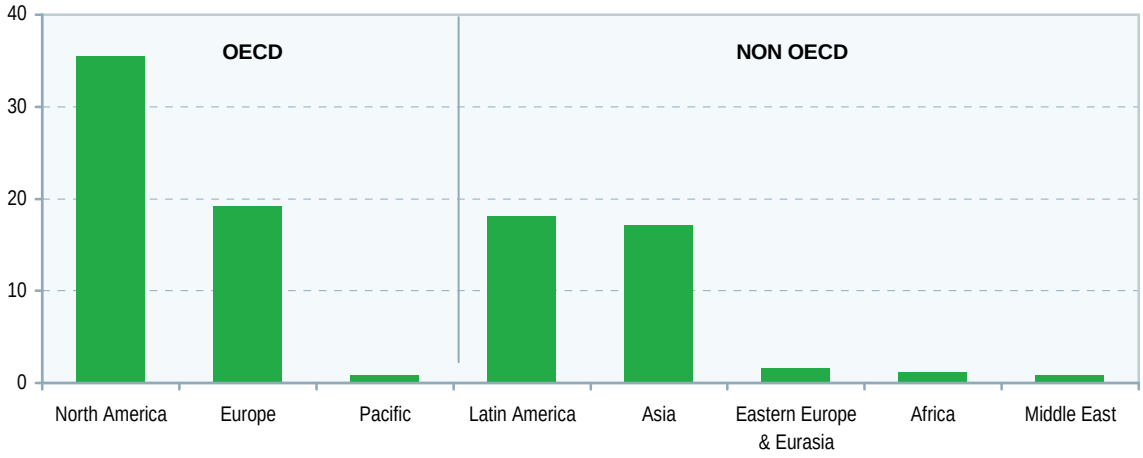
Chart III.1: Projected biofuel consumption (mtoe)



Source: IEA (2009)

The International Energy Agency (IEA) expects biofuels' share of the total supply of road transport fuels globally to rise from around 1.5% currently to 5% by 2030, driven by continued high energy prices and supportive government policies. As Chart 3.2 illustrates, the growth is expected to come predominantly from North America, Europe, Latin America, and Asia.

Chart III.2: IEA projections for growth in biofuel consumption, by region (mtoe)

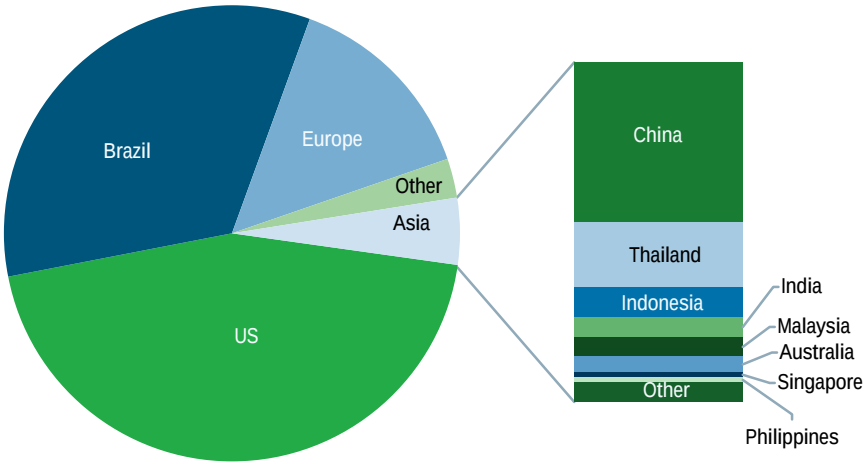


Source: IEA (2009)

Ethanol currently accounts for around 83% of the biofuel market and is produced mostly by the US and Brazil. Biofuel output took off in the 1970s and 1980s in reaction to high oil prices, with Brazil at the forefront due to proactive government policies and incentives. Output only started to grow to commercial quantities around 2003 in the US.

Food commodities are an important feedstock for existing biofuel technologies. Brazil uses sugarcane as a feedstock, while the US uses corn almost exclusively. The share of ethanol in US gasoline supply grew from just over 1% in 2000 to 7% in 2008, while in Brazil, ethanol now accounts for around 18% of gasoline supply. The EU is the largest biodiesel producer, and rapeseed oil is its main feedstock.

Chart III.3: Biofuel production, 2008 (mbd)



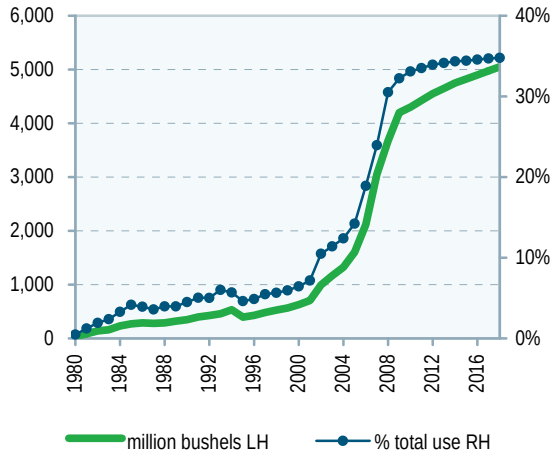
Source: IEA (2009)

Growth in biofuel production and consumption is largely policy-driven, as profitability is poor for most types without government support. While 1.5% of road transport fuels globally does not sound like much, biofuels have been an important source of

incremental supply during periods when the crude oil market has been particularly tight.

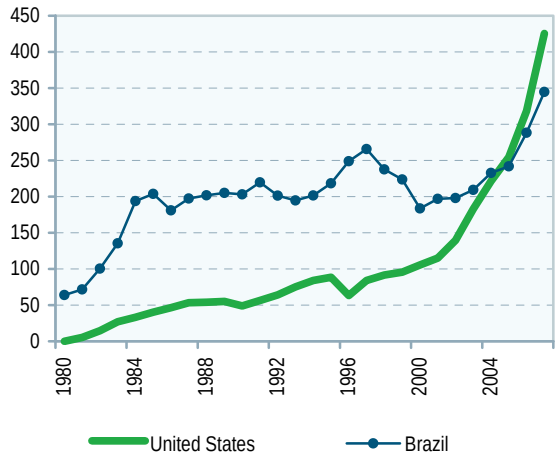
Availability of land will be a limiting factor for output. Second-generation biofuels, which use non-food sources such as lignocellulosis feedstocks (grasses, etc.), are under development and would potentially have less of an impact on food prices. However, they are a long way from commercial development at this point.

Chart III.4: US – corn for fuel ethanol



Sources: USDA, SCB Global Research

Chart III.5: The US has overtaken Brazil as the largest ethanol producer, 000bbl/day



Sources: EIA, SCB Global Research

In 2006, around 1% of arable land was devoted to biofuel feedstock production, meeting 1% of global energy needs, the IEA estimates. That proportion is now closer to 1.5%. Competition for arable land will likely push up land and commodity prices, with a positive impact on investment in the agricultural sector but a negative impact on food prices in the near term.

Policy drivers – set to continue despite environmental concerns

The drive to expand biofuel production suffered from a backlash as food prices escalated in 2007-08 (although biofuels were not solely to blame), and there is considerable debate about the environmental impact of biofuel production. However, we believe that there is sufficient momentum to support continued growth. Table 3.1 outlines current government mandates for biofuels.

Table III.1: Current mandates for biofuels

Country	Feedstocks (ethanol)	Feedstocks (biodiesel)	Current blending targets
Brazil	Sugarcane	Castor seed, soybeans	20-25% ethanol blending ratio with gasoline (E25) in place; 5% biodiesel blend by 2010.
Canada	Corn, wheat, straw	Animal fat, vegetable oils	5% ethanol content in gasoline by 2010; 2% biodiesel in diesel by 2012.
China	Corn, wheat, cassava, sweet sorghum	Used and imported vegetable oils, jatropha	Approved 10% blending ratio of ethanol in gasoline in six provinces and regions, with a target of blending 2mt of ethanol in gasoline by 2010 and 10mt by 2020.
EU	Sheat, other grains, sugar beets, wine, alcohol	Rapeseed, sunflower, soybeans	5.75% biofuel share of transportation fuel by 2010, 10% by 2020.
India	Molasses, sugarcane	Non-edible oil seeds in wastelands	10% ethanol-blended petrol in 2009. Minimum 20% ethanol-blended petrol and diesel across the country by 2017.
Indonesia	Sugarcane, cassava	Palm oil, jatropha	10% of subsidised and 20% of non-subsidised diesel for transportation should be made up of biodiesel by 2020; Increasing biodiesel usage levels in the country's industrial and commercial sectors in stages to 20% by 2025.
Malaysia	None	Palm oil	5% biodiesel blend used in public vehicles; government plans to mandate B5 in diesel-consuming vehicles and in industry in the near future.
Thailand	Molasses, cassava, sugarcane	Palm oil, used vegetable oil	2% blend with 98% diesel introduced in February 2008; the use of a 5% blend nationwide to be required by 2012.
United States	Corn, non-corn starch	Soybeans, other Oilseeds, animal fats, recycled fats and oil	RFS2 provision establishes a target of 15bn gallons of conventional ethanol by 2015 and at least 21bn gallons of cellulosic (non-corn starch) ethanol and advanced biofuels (including ethanol from sugarcane and biodiesel) by 2022

Sources: USDA, Reuters, SCB Global Research

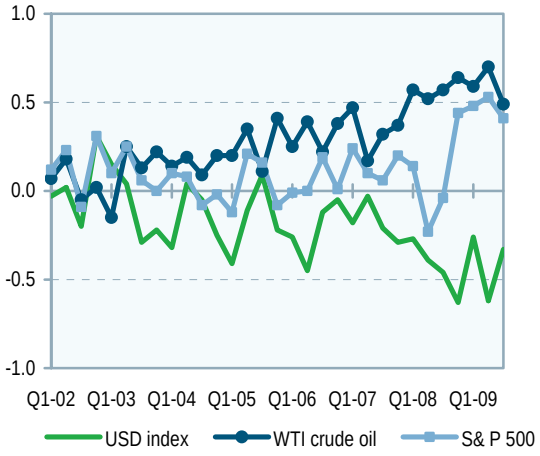
Implications for food prices

Competition between the biofuel and food sectors for food commodity inputs will put upward pressure on prices going forward. Prices are also likely to become increasingly correlated with energy prices as the biofuel sector expands. This is already evident in correlations between WTI crude oil and various agricultural commodities (Chart III.7).

Overall, agricultural commodity prices have become much more correlated with macro factors such as USD weakness, equity prices, as well as changes in energy prices (Chart III.6).

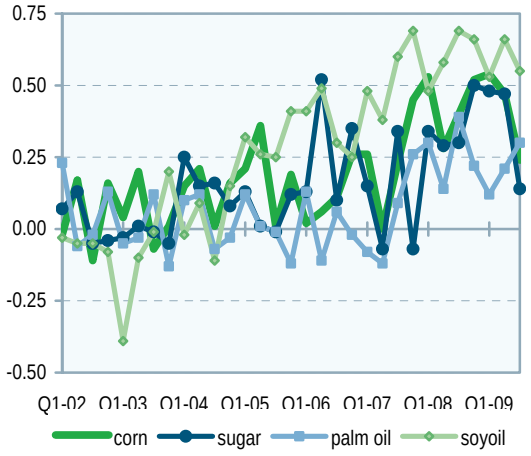
In theory, this is driven by competition for inputs between the food and biofuel sectors. In reality, the moves are accelerated and, at times pre-empted, by investor flows in the futures markets. The impact goes beyond immediate feedstocks to competition for given acreage. This is particularly striking for corn and wheat in the US.

Chart III.6: Correlations with DJ UBS agricultural commodity index (quarterly)



Sources: Bloomberg, SCB Global Research

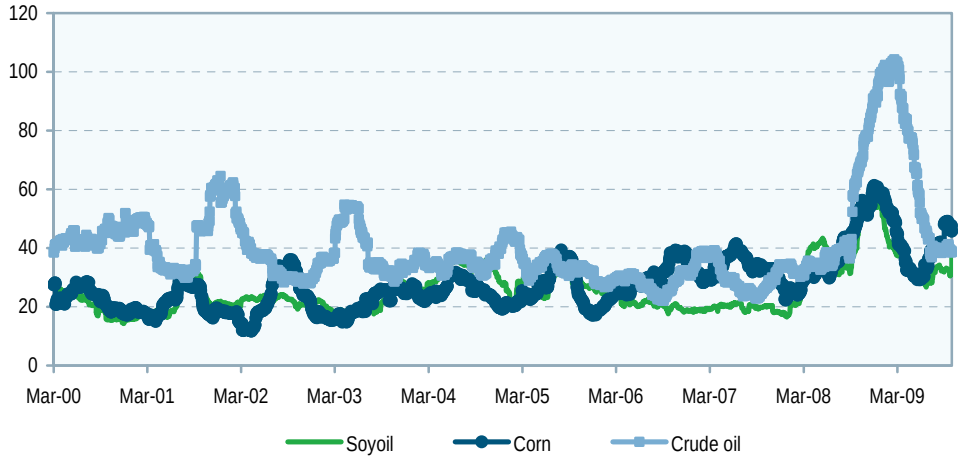
Chart III.7: Correlations with WTI crude oil (quarterly)



Sources: Bloomberg, SCB Global Research

Volatility may also be affected, although agricultural prices already exhibit considerable volatility. The impact of commodity investment flows on volatility is ambiguous – while high levels of speculative investment leave the markets vulnerable to shifts in sentiment and macro factors, they do add liquidity. Smaller, less liquid commodity markets which attract lower investor flows also exhibit high levels of volatility. However, looking at historical volatilities for corn, sugar, and crude oil does suggest some convergence since 2000 (Chart III.8), although oil price volatility was still much higher in the 'boom and bust' of 2008.

Chart III.8: Historical volatilities (3-month) for energy and food commodities



Source: Bloomberg

IV. Challenges – water and climate change

Food supply depends on sufficient water resources

Water and agriculture

Freshwater is vital to agriculture – production of 1 tonne of grain typically requires about 1,000 tonnes of water. Though water covers about two-thirds of the Earth's surface, only 0.8% of it is freshwater available for human use. The available water is also spread very unevenly, with abundance in some areas and severely limited availability in others. In many areas of the world, particularly in Asia, Africa, and the Middle East, water is an extremely limited resource.

Demand for water continues to grow, not just with population growth but also on a per-capita use basis, as domestic and industrial demand outpaces even agricultural demand. The water sector has also suffered from significant underinvestment and a failure to value water properly, resulting in inefficient or inappropriate use of a scarce resource. Without increased recognition of the importance of water and greater investment, the estimated number of people subject to severe water scarcity, and potentially unable to grow sufficient food, will exceed 2.8 billion by 2025. Thus, the outlook for water supply is grim.

The agricultural sector is highly water-intensive, consuming around 70% of all freshwater available globally, and 82% in low- and middle-income countries. While water usage has doubled over the past century, its efficiency has barely improved. A number of factors have driven the increased use of water in the agricultural sector. Food consumption had increased since the 1960s, helped by the introduction of irrigated agriculture, which has enabled increased per-capita food production at lower prices. The world is also consuming more food as the population increases. Moreover, people tend to consume more meat than cereal as their economies develop and thrive, and meat can require up to 10 times more water than cereal to produce the same calorie content.

All of these factors have combined to stretch the use of water for food production. With large areas of the world facing the threat of serious water shortages in 20 years' time, the risk of a knock-on food shortage is clear – especially as the sheer number of people now seeing improvements in their standards of living, and thus water and food consumption, is unprecedented. Without adequate supply of water, increased food production will not be possible.

China's water resources have been diminished by pollution

The pollution problem

Pollution is also a severe problem in some areas. This is most evident in China, where 30 years of rapid industrialisation have left water resources severely polluted, exacerbating an already-chronic water shortage. China has 22% of the world's population and only 7% of the world's freshwater – and leaving up to 50% of water resources in some regions unusable for any purposes.

In China and elsewhere, demand for water has led to the depletion of below-ground aquifers. Though these are renewable, they are being depleted at many times their natural rate of replenishment, resulting in falling levels. In parts of the North China Plain, groundwater levels have fallen by hundreds of metres in the past 30 years. This depletion is being driven to a large extent by the need for food security as China

strives to feed its huge population from domestic sources – China is the world's biggest grain producer, producing 500mn tonnes per annum. However, the depletion of aquifers is unsustainable and, unless addressed, could lead to big drops in production in key grain-growing regions.

Increasingly volatile weather is also compounding problems in regions already hard-hit by inadequate water supply. The FAO forecasts climate change will account for about 20% of the global decline in water availability over the next 20 years. By some forecasts, a one-degree increase in global temperature could cause glaciers in the Andes to melt, threatening water supply for 50 million people globally. We discuss the intimate link between climate change and water scarcity below.

The lag in development of good-quality water infrastructure is compounding already-strained water resources in all parts of the world. The technology for efficient delivery and re-use of scarce water is available but is not being deployed as inadequate regulation, lack of capital, or simply a lack of adequate data on water resources hamper investment.

The good news is that the world has sufficient water to meet agricultural and all other needs. But this will require investment and a flexible approach to the use of water, especially for agriculture, and especially where food security is concerned.

Existing resources and their use: a case study of the Middle East

Today, most countries in the Middle East already suffer from, or are approaching, water scarcity. According to AQUASTAT statistics, only Algeria, Iran, and Oman can meet their water needs with their current resources. In extreme cases such as the UAE and Saudi Arabia, annual water use is up to 10 times higher than available resources. Almost every country in the Middle East is expected to experience water scarcity by the year 2025.

Water scarcity is the most crucial factor in MENA food production

Water scarcity translates into strains on food supply in the region. As in other parts of the world, the vast majority of water resources in the Middle East are used in the agricultural sector. Yet despite this, Middle Eastern countries also import large amounts of water-intensive agricultural products. Most of them import over 50% of their grain consumption. This share will only given the shortage of water and increasing demand from household and industrial users.

Saudi Arabia has aimed to achieve food independence since the 1980s. The government has pushed wheat production aggressively, and in 1992, Saudi Arabia became the world's sixth-largest wheat exporter. However, the government is winding down the initiative in an effort to save water. Indeed, the water needed to irrigate one hectare of land to grow agricultural produce in Saudi Arabia is two to three times higher than the volume needed to grow the same commodity in temperate conditions, and that water could be much more productively used in other parts of the economy. It is becoming increasingly evident to Middle Eastern countries that using water for agriculture is not economically efficient. The thorny issue, however, is food security or, more accurately, insecurity. Saudi Arabia faces the same dilemma as China of whether to trust world markets and import food or try to continue to feed a rapidly growing population from secure domestic sources.

It would be interesting to see global convergence on the price of water and to see fully opened markets for agricultural commodities. This would result in more stable global

food supply and allocation. Unfortunately, food insecurity, climate change, and divergent policies across countries prevent this. It is clear that the world needs to start using water in a more sustainable and efficient manner, especially in agriculture, to address water imbalances and shortages – particularly in the developing regions of the Asia, Africa, and the Middle East. Potential solutions include investment programmes that improve water efficiency, the scaling back or reassessment of agriculture in countries with strained water resources, increased international trade in bulk agricultural products, additional research on desalination technologies and drought-resistant crops, and ultimately, reform of water allocation and pricing.

Climate change threatens water supply and agricultural yields

Climate change, the weather, and agriculture

The earth's climate is changing, probably as a result of the increase in emissions of CO2 and other greenhouse gases (GHG). The Intergovernmental Panel on Climate Change (IPCC) estimates that the earth's average temperature will rise by between about 1-4°C by the year 2100. Sea levels will also rise by 0.5-1.0m by 2100, the IPCC estimates. These estimates are conservative, as numerous other studies predict bigger, quicker temperature changes or much greater sea-level rises (ranging from 2m to 7m). Based on the IPCC numbers, we expect substantial inundation of coastal land and significant changes to climatic conditions for agriculture. Though the precise effects of climate change are almost impossible to predict, Table IV.1 sets out the likely effects of a 2- 5°C increase in temperature as outlined in the Stern Review.

Table IV.1: Impact of temperature increases

Temp. rise	Water	Food	Land	Environment	Sudden events
2°	20-30% decrease in water availability in key regions, e.g. southern Africa and Mediterranean	Sharp decline in crop yields in tropical regions (5-10% in Africa)	10mn people affected by coastal flooding each year	15-40% of species face extinction (according to one estimate)	Potential for Greenland ice sheet to melt, resulting o in an eventual 7m sea-level rise
3°	Serious droughts in southern Europe every 10 years	150-550mn additional people at risk of hunger	1-170mn more people affected by coastal flooding each year	20-50% of species face extinction; possible onset of Amazon rainforest collapse	Rising risk of sudden changes in weather patterns, e.g. the monsoon
4°	Potential 30-50% decrease in water availability in southern Africa and Mediterranean	15-35% decline in agricultural yields in Africa and entire regions of Australia	7-300mn more people affected by coastal flooding each year	Loss of around half of Arctic tundra	Rising risk of Atlantic Thermohaline Circulation (Gulf Stream)
5°	Possible disappearance of Himalayan glaciers, affecting one-quarter of the populations of China and India	Increase in ocean acidity, possibly seriously disrupting fish stock	Sea-level rise threatens small islands, low-lying coastal areas (Florida, Bangladesh) and major world cities		

Source: The Stern Review

Beyond a 5° increase, few models provide meaningful results, but food production would likely be severely disrupted and large-scale population movements would likely occur.

The key threats to food production arising from rising temperatures are availability of water and negative changes to yields (even accounting for the 'carbon fertilisation' effect, which is the additional growth seen in certain crops as CO2 concentration levels rise). There will probably be as much rainfall as at lower temperatures, though the air will be able to hold more moisture at a higher average temperature), but all models point to increased volatility of rainfall. There will be less predictability and more concentration, which is exactly the opposite of what is required for agriculture.

Certain regions will also become more productive, especially Northern Europe and parts of North America. But these are the very areas where productivity is already high, and further gains may therefore be more difficult. In all scenarios, the worst-affected countries are in Asia, Africa, and the Middle East, as well as Australia, as renewable water resources will fall and temperatures will rise beyond critical crop temperature thresholds. Thus, much of the 'spare' land that is expected to be brought online will likely be compromised and will require much higher capital inputs to achieve desired yields. At the same time, regional food insecurity is likely to rise further.

Agriculture is also a key contributor to CO2 emissions, and therefore probably to climate change as well. Emissions from livestock and agriculture, including deforestation, fertilisers, and food transport, account for about 40% of all GHG emissions. If the human population reaches 9 billion or more by 2050, assuming a business-as-usual model (including changing diets as the world gets wealthier), emissions will increase by about 50%. The widely cited goal of reducing total emissions by 60% by 2050 in order to stabilise temperature rises will require radical adjustments, as without reform, the emissions generated by providing food for the world's population would rise to 150% of all GHG emissions.

Climate change is likely to limit new food supply. The agricultural sector will also be under pressure to reduce emissions involved in food production, which could also limit increases in yields. Climate change will be among the most challenging issues facing agriculture going forward and will require a full range of solutions: maximising yields through the use of GM crops which can withstand higher temperatures, investing in the provision of consistent water availability, focusing on production in the most favourable climatic zones, and reviewing fertiliser use and farming techniques, among others.

Weather – the X factor

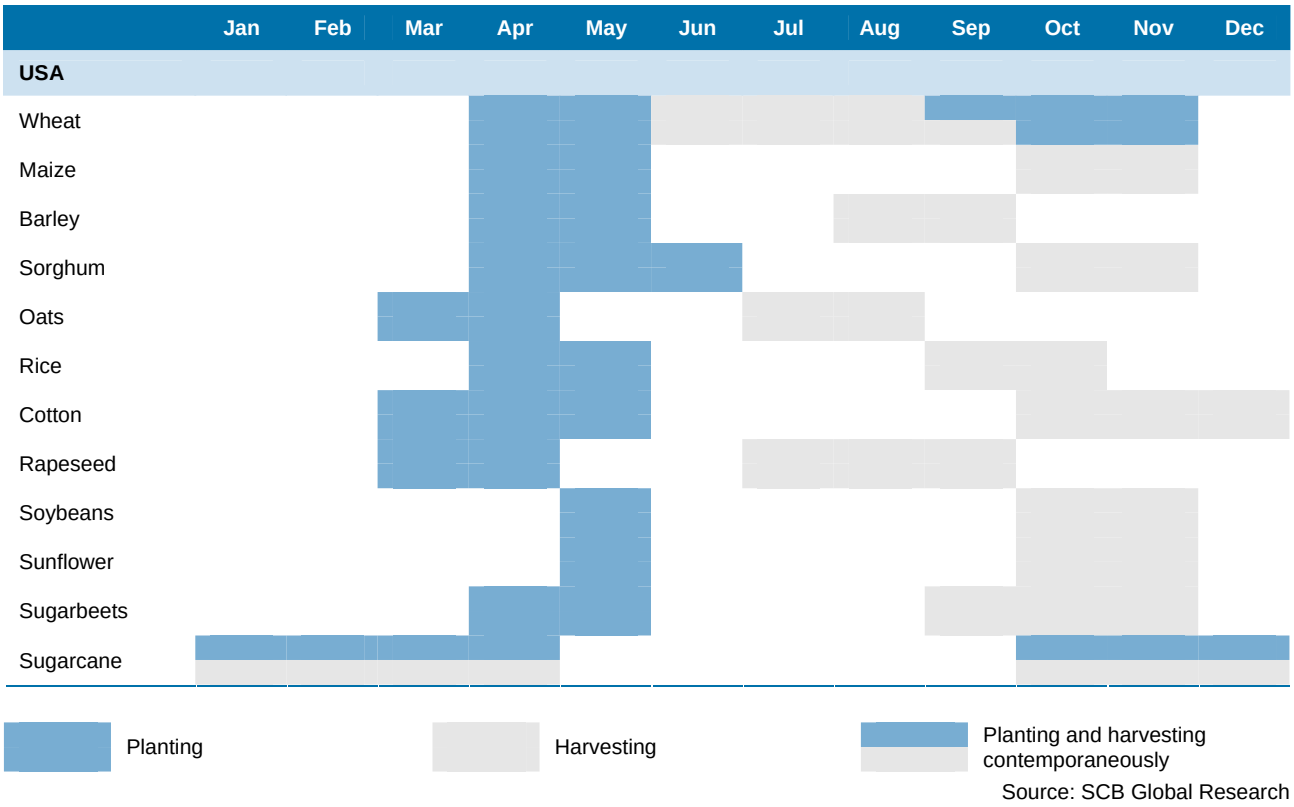
The weather continues to be the most important determinant of global output and yields, especially due to the fact that certain weather conditions are necessary for the life cycle of plants.

These conditions vary regionally and for different crops, but plant and weather needs have to be matched. Historical weather patterns are already changing, with more unusually hot days; heavy downpours have become more frequent and intense, and droughts are becoming more severe, according to the US Government's Climate Change Science Program. Most climate models predict more rainfall in the northern and southern latitudes and less in the sub-tropics, and greater risk of both droughts and floods. Extreme weather events are also predicted to rise substantially, and long-standing weather patterns, e.g. the monsoon, may change.

All of these factors will affect food production – some positively, many negatively – as weather patterns become less stable. Recent examples are the twin negative impacts on the sugar market from flooding in Brazil and inadequate monsoon rains in India – bringing damage to yields from both too much and too little water. Adaptation will be required to adjust to the new 'abnormal' weather conditions.

Table IV.2: Crop life cycle, northern hemisphere

Dry weather is typically required during planting and harvesting



Source: SCB Global Research

El Niño highlights importance of benign weather conditions

The need for good weather takes on added importance when one considers the prevalence of dry weather conditions globally, highlighted by current concerns about an imminent El Niño weather event. El Niño refers to the seasonal warming of ocean temperatures along the coasts of Ecuador and northern Peru at the end of each calendar year. Much stronger warming occurs every two to seven years. The event is closely linked to a global atmospheric oscillation known as the Southern Oscillation. According to the US National Weather Service, El Niño events are usually (but not always) associated with below-normal rainfall in the second half of the year across large parts of southern and inland eastern Australia. Some of the most prominent temperature departures include:

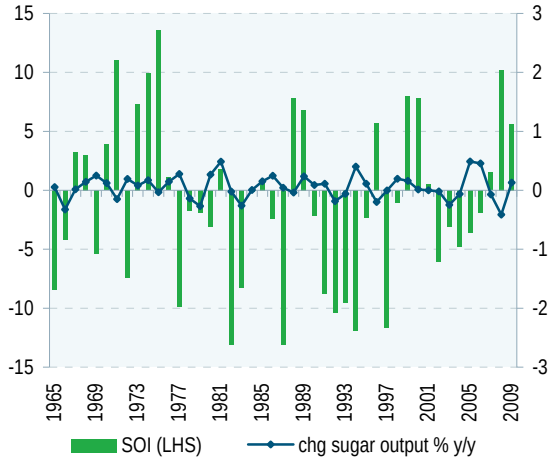
- Warmer-than-normal conditions during December-February across South East Asia, south eastern Africa, Japan, southern Alaska, western/central Canada, south eastern Brazil, and south eastern Australia
- Warmer-than-normal conditions during June-August along the west coast of South America and across south eastern Brazil
- Cooler-than-normal conditions during December-February along the US Gulf coast

During El Niño events, Indian monsoon rainfall tends to be below normal, especially in India's north western states. Current weather conditions now indicate a moderate to low El Niño event, which has been associated with dry weather in India.

The crop fallout as a result of El Niño can be severe. India's sugarcane output has so far been the worst-affected, leading to a global deficit in sugar output due to India's position as a major producer and the world's largest consumer of sugar. El Niño conditions can also affect palm oil, wheat, rice, and cocoa output, given that these crops are produced in South East Asia and Australia.

Chart IV.1: El Niño and India's sugar output, mt

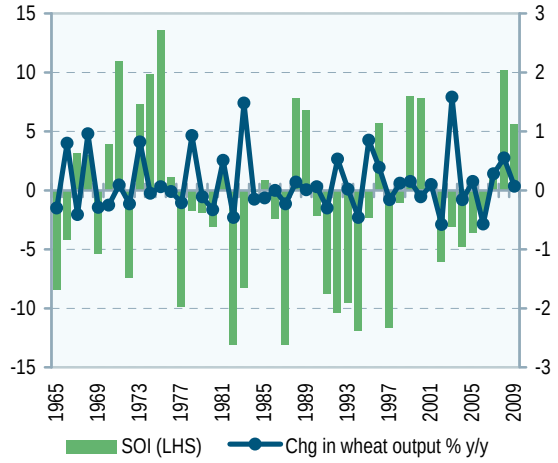
Sustained negative SOI values indicate El Niño



Sources: USDA, ABM, SCB Global Research

Chart IV.2: El Niño and Australia's wheat output

Sustained negative SOI values indicate El Niño



Sources: USDA, ABM, SCB Global Research

There are two dominant issues related to El Niño. Firstly, El Niño weather patterns are probably impacted by climate change. According to the US National Oceanic and Atmospheric Administration (NOAA), the increasing incidence of El Niño in recent decades correlates with rising global temperatures. Secondly, dryer weather tends to disproportionately affect less-developed countries in Africa, Asia, and the Middle East, due to poor farming infrastructure and irrigation techniques as well as natural freshwater shortages.

Changing weather patterns have implications for land and yields. Agriculture and agricultural techniques need to adapt to climate change. This will require that investment in farming be prioritised within the objective of overall economic growth to ensure adequate infrastructure to cope with more volatile conditions. To maintain or improve yields under these non-traditional conditions will require the adoption of non-traditional techniques and methods, including a focus on genetically modified crops. Changing weather patterns and their adverse impact on output may also require looking beyond current land supply to alternative land supply with less vulnerability to adverse weather, or investing in adaptive infrastructure, such as rainwater storage and irrigation to cope with less frequent, heavier downpours.

In short, the weather is changing, and farming will have to change with it.

V. Africa – unrealised potential

Sub-Saharan Africa could be a key new supplier but faces many challenges

The food crisis that impacted the third world in 2007-08 had an acute impact on Sub-Sahara Africa, threatening the food security of those countries dependent on food imports. The experience has refocused attention on agriculture, which was neglected for decades by African policy makers and donors. Food security is firmly back on the policy agendas of many countries.

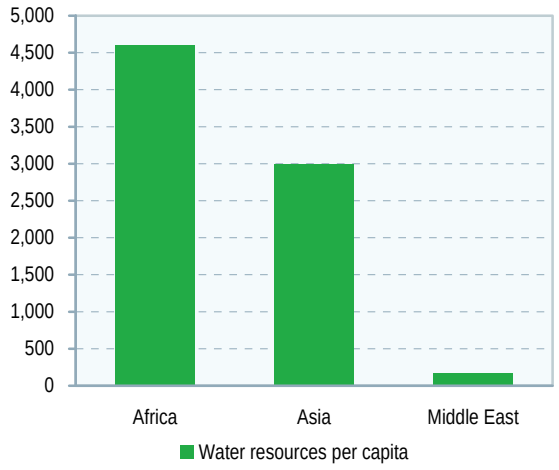
There are good reasons for optimism about Africa's agricultural prospects. The continent is relatively land-abundant, land utilisation rates are low, and the productivity of land under cultivation has room to be increased significantly. While a number of factors have weighed on the progress of farming, many of these are starting to be addressed. Indeed, as the world's appetite for land and food grows inexorably, and as the African investment climate improves, Africa looks set to emerge as the key destination for 'frontier' agricultural investment.

The state of play in African agriculture

Africa has abundant arable land and water relative to Asia and the Middle East (Charts V.1 and V.2). According to the FAO, Africa's per-capita water resource averages 4,600m^3, compared with 3,000m^3 in Asia and just 164m^3 in the Middle East. Not only are Africa's agricultural endowments considerable, but they are underutilised too. The FAO estimates that less than 15% of Africa's total arable land is under cultivation (Chart V.2).

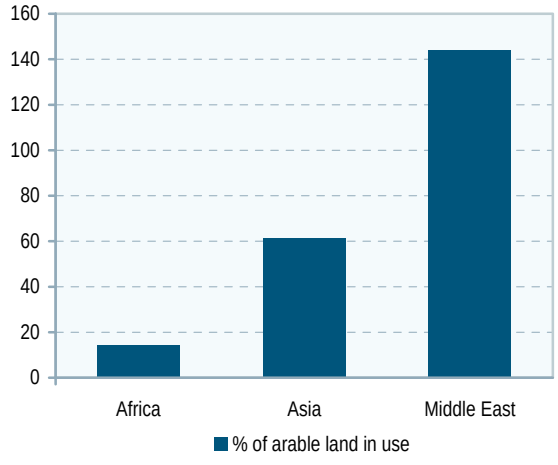
Despite its potential, Africa is not food self-sufficient (it is a net food importer – see Chart V.4). In addition, yields from cultivated land tend to be low. Chart V.3 shows anaemic growth in yields in Africa compared with other regions, resulting in much lower yields than the averages in other regions.

Chart V.1: Africa has relatively abundant water …



Source: FAO AQUASTAT

Chart V.2: … and arable land suitable for rain-fed agriculture



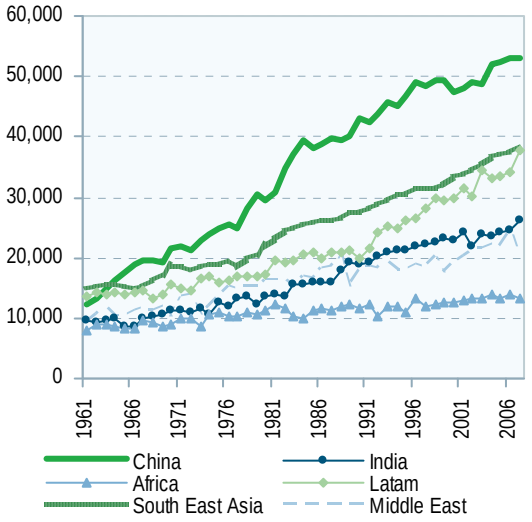
Source: FAO

The 'green revolution' of the 1960s, which sowed the seeds of the astonishing economic progress made by many countries in Asia, has not yet occurred in Africa for a number of reasons:

- Following independence, agriculture was neglected in many countries as policy makers favoured industrialisation and urban development. In some cases, this urban bias was directly detrimental to the farm sector.
- Diverse food crops and agro-ecology across the continent, including conditions unique to Africa, have made it difficult to apply Asia's 'green revolution' model
- A lack of investment and financing has been the key impediment to the development of agriculture (Chart 5), and it is worth noting that agriculture has not been a sustained priority for Official Development Assistance (see Chart 6).

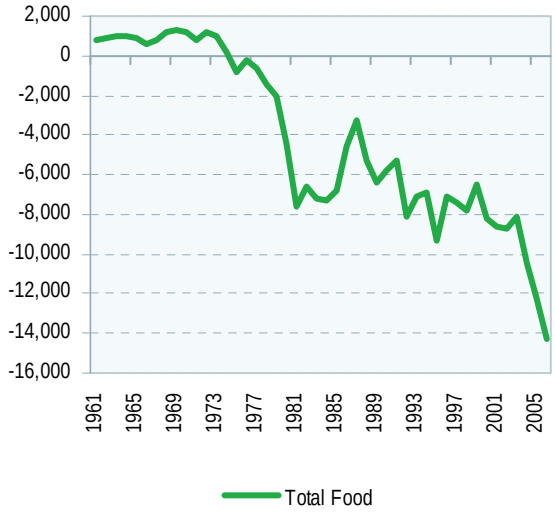
The result is continued dependence on rain-fed agriculture, low use of fertilisers, low investment in research and development, and poor infrastructure. Key constraints to investment, in turn, have been a generally poor investment climate and complex tenure arrangements. The FAO estimates that 90% of land in Africa is not covered by formal legal frameworks. This is a daunting problem for prospective investors, and also reduces investment incentives for those currently utilising the land.

Chart V.3: The green revolution has not yet reached African yields …



Source: FAO

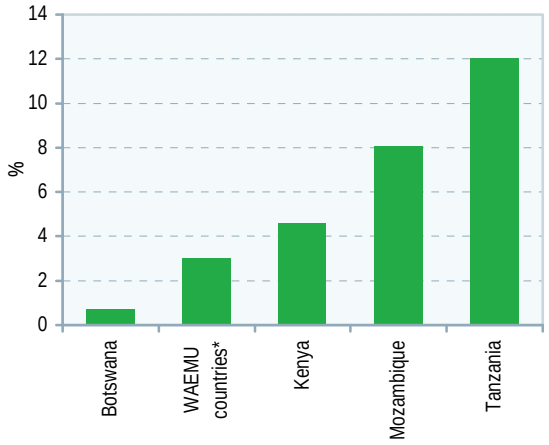
Chart V.4: … resulting in strong growth in net food imports



Source: FAO

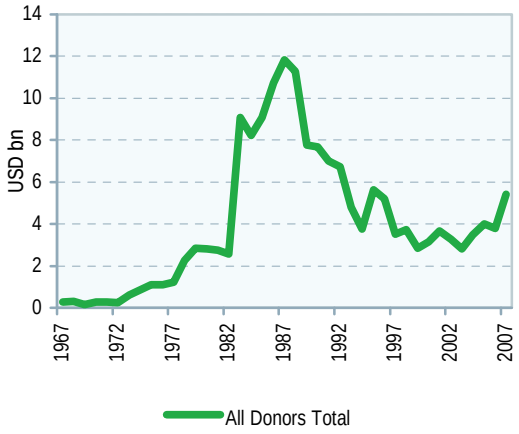
Due to these challenges, and the faster growth of non-agricultural sectors, agriculture's contribution to GDP has declined in most African countries. This belies the fact that agriculture remains of central importance to African countries' economic prospects, and that most Africans still work on farms (agriculture represents on average 34% of GDP and 64% of employment, according to the World Bank).

Chart V.5: Agriculture draws a low proportion of domestic lending



Source: Central Banks, SCB Global Research

Chart V.6: Agriculture has also been neglected by donors (ODA to agriculture, USD bn)



Source: OECD

The constraints can be overcome but will require strong government action and international support. Farming clearly remains integral to many African economies, and given the sector's immense growth potential, we expect policy makers, donors, and investors to place a growing emphasis on this sector. This is already becoming evident in improved multilateral resources and government agricultural plans.

Towards a green revolution

Developing agriculture is important to establishing food security and reducing poverty. In fact, World Bank studies show that agricultural growth has a much larger effect on poverty reduction than growth in any other sector, sealing the policy advocacy argument in favour of pro-farming measures. The food crisis has spurred governments to launch agricultural plans, and major donors have committed more funds to agriculture. There is no universal solution to the problems of the agricultural sector, but farming clearly needs to return to the top of the development agenda, and investment is the key.

While government action is vital, private-sector development and support will also be crucial for further agricultural development. Improving the business climate, increasing access to financing, and addressing land property rights issues will help stimulate such investment. Infrastructure deficiencies must be addressed, as these have been shown to constrain agricultural development (raising input costs for both commercial and subsistence farmers and preventing products from reaching local urban or international markets). Available water resources must be harnessed to increase irrigation. Improvements in input supply chain and utilisation (notably seeds and fertilisers) are critical to the supply response. In order to boost yields, investment is needed in agricultural research and development tailored to African growing conditions. In the long run, R&D is of particular importance given the new challenges arising from climate change.

Access to finance must be improved. Small farmers find it difficult to accrue the necessary assets to secure the financing they need. Traditional financing models require that collateral is secured from farmers' physical assets and balance sheets.

Financial institutions need to develop more innovative financing structures which provide increased benefits to farmers as well as mitigating risk, thereby unlocking access to credit. The existence of extensive subsistence rather than commercial farming in Africa suggests a significant opportunity for microfinance.

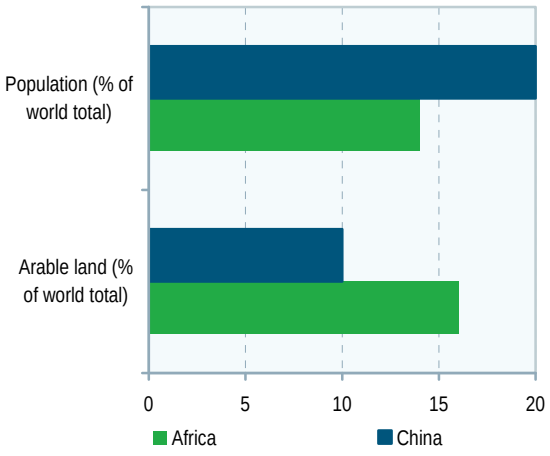
While the challenges are clear, there is no consensus on the best development model for agriculture. Recently, there has been much debate over the merits of commercial versus subsistence farming, and the role of foreign investors. Commercial farming has enormous room to grow, but improving the productivity of small-scale agriculture is also important in order to achieve food security and decrease rural poverty.

The new scramble for African land

African countries are increasingly in the sights of foreign investors seeking new farmland – notably from resource-constrained Middle Eastern and Asian countries. Large-scale cross-border farmland purchases and usage agreements are on the rise across the globe, and have attracted growing attention in recent years. Comprehensive statistics on these deals do not yet exist, but what is certain is that Africa is a key locus of this global trend. Since 2006, deals have been concluded in at least 12 African 'host' countries, with sovereign or private-sector counterparties in 14 investor countries. Net food-importing countries with fast-growing economies (and, frequently, populations) naturally dominate the ranks of countries pursuing food security through the acquisition of rights to foreign soil.

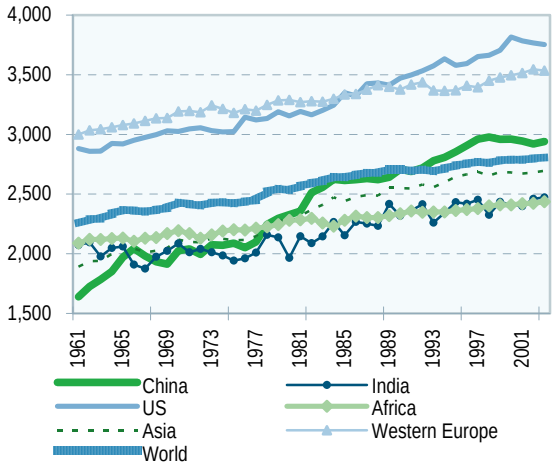
The total farmland involved in just the limited sub-set deals for which data is available amounts to 8.66mn hectares, according to the International Food Policy Research Institute (IFPRI) – about the same size as Italy's arable land endowment. Clearly, Africa's farmland is attracting foreign investors, and the scale of transactions is already material.

Chart V.7: In China, 'the land is little and the people are many', while in Africa the opposite is true



Source: FAO

Chart V.8: Rapidly rising food consumption



Source: FAO

China's involvement in Africa likely to shift towards land acquisition

Multiple models for foreign land transactions are emerging, but the choice of target country is influenced by various factors: the availability and price of agricultural land, geographic proximity (nearby countries are favoured), and international relations, with confidence in the sovereign counterparty, and pre-existing cultural and economic links, playing a role. An analogy can be drawn between energy policy and food policy, as the securing of food supplies as a strategic priority co-exist with the need to secure energy supplies in a global market.

In principle, the growing trend of foreign land investment in Africa could spur progress in the form of investment in agri-supportive infrastructure. Transfers of skills and technology, as well as increased local employment, are realistic prospects. However, uncertainties and political sensitivities abound. Land, more than simply being a tradable commodity, is integral to the identities of local communities. It may be bound up in national sovereignty and pride, and it remains fundamental to the livelihoods of the majority of people in most African countries. The prospect of potentially food-insecure countries ceding food production resources to outside interests is an uneasy one. The establishment of best practices – facilitated by guidelines which are now in the process of being drawn up by international institutions – will be helpful. Transparency, sustainability, and a meaningful return for local communities will be fundamental ingredients.

However, the trend of foreign investment in African agriculture goes beyond the food security concerns of foreign governments. For example, many investments in biofuel, driven entirely by private-sector interests, are also underway. Opportunities in agriculture (and in higher-value-added agribusiness more generally) in Africa are beginning to attract substantial foreign investor interest. Provided that the policy environment continues to evolve favourably, and that supportive financial conditions develop, agriculture and related downstream activities in Africa look set to grow.

VI. Asia – the swing factor

Asia's large production and vast population ensure that it dominates the demand-supply balance

Asia's vast size ensures that a wide variety of food issues affect different locations. However, due to its huge population, combined with rapid economic growth rates, Asia is far and away the most important influence on global food demand. It is also the world's biggest supplier of food, but because there is little spare land and production is already quite intensive, with good yields, the possibility of dramatic increases in supply may be limited. Add in climate change, environmental damage, and water scarcity, and even maintaining supply may become an issue.

Asia (excluding the Middle East) is home to about 60% of the current world population. Even if current population growth rates are lower than in the past, the absolute numbers are huge, with more than 20 million people forecast to be added each year on average to 2050. These people are also getting richer at a faster rate than ever before, now that India's and China's economies are growing at 6-10% or more per year. Although more than 500 million people are still undernourished in Asia, the region's impact on food consumption is large. If the supply/demand balance changes even slightly, the impact on world food prices could be dramatic. We have focused this part of the report on China and India due to their sheer size.

China's economic growth will drive increased food imports

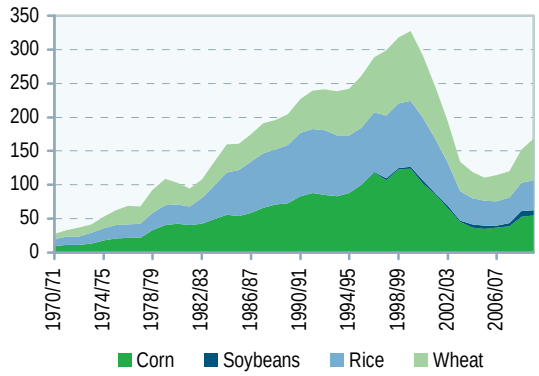
China

China is the global powerhouse in terms of agricultural production, consumption, and trade. It accounts for 20% of total production of corn, 30% of rice production, and 17% of wheat output. It accounts for 16%, 30%, and 20% of global consumption of wheat, rice, and corn, respectively. China is the primary export destination for soybeans, absorbing 70% of US soybean exports and 50% of global exports.

Near-term outlook

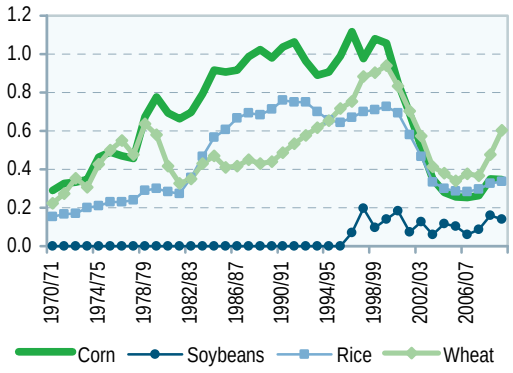
China is generally self-sufficient in grains (wheat, rice, and corn), with total production of around 500mt. Overall, grain stocks in China appear sufficient to meet consumption this season. However, severe drought conditions this year in the grain-

Chart VI.1: China grain ending stocks, mt



Sources: USDA, SCB Global Research

Chart VI.2: China grain stock-to-use ratio



Sources: USDA, SCB Global Research

producing regions of Inner Mongolia, Xinjiang, Jilin, Shanxi, and Liaoning risk adversely affecting total autumn grain output. A 5% shortfall in the overall harvest would potentially require 20% of current global grain exports to meet China's annual needs, though domestic stocks would be drawn down first.

Longer-term outlook

Looking first at the demographics, while China's population growth has slowed dramatically recently, its population is still growing by about 18 million people per annum. This, along with decades of strong income growth, has caused dramatic changes in China's total food intake and the breakdown of its diet. Over the past decade, China's per-capita consumption of corn, sugar, palm oil, and soybeans has been on the rise, while consumption of wheat and rice has trended down. People with rising incomes demand higher-protein meals and more vegetable oils. These trends are likely to continue, currently China consumes only about half as much meat per capita per annum as Singapore or two-thirds as much as Taiwan. Meat consumption is closely linked to GDP growth and GDP is forecast to continue to grow in China at an average of 8% or more for the foreseeable future which would lead to meat consumption catching up with more developed nations. If food prices pick up as expected, the impact on rural incomes should be positive. This will in turn drive higher food demand as parts of the country which were previously left behind in the country's economic transformation play catch-up.

Although ending stocks of key grains in China have trended down in recent years (see Chart IV:1), China has still been able to meet its wheat, corn, and rice requirements without recourse to export markets, as final demand for grains has fallen on a per-capita basis. Ignoring the impact of water issues and climate change, we could expect China to maintain its self-sufficiency in wheat, corn, and rice until 2050 if output growth continued, but not in sugar, palm oil, or soybeans. That output growth is probably very reliant on land reform and especially the agglomeration of farms into larger, more efficient units. Though this might also have the effect of lowering grain production and endangering self-sufficiency as more commercial farmers would look at higher value non-grain foods such as vegetables or meat.

However, this is optimistic given trends in arable land expansion and yields in China over the past two decades. Using harvested area as a proxy for arable land, we note that total harvested area in China for corn, soybeans, rice, and wheat has remained largely flat since 1990 at around 92.7mn hectares (ha), and there have been only slight increases in yield. Urbanisation will likely continue to reduce available arable land, as will desertification but the central government has attempted to put in place tougher restrictions on the conversion of agricultural land with the 1998 land Administration Law. Conversion to residential or industrial use often now requires State Council approval.

If one takes into consideration the severe water issues, of both quantity and quality, as well as the likely impact of climate change, then food supply may be quite significantly constrained despite the maintenance of land supply. An example is the wheat-growing area on the Great Northern Plain, which currently produces two crops a year. These crops rely on groundwater from an underlying aquifer. This aquifer is currently being drained rapidly, with water tables falling, which may result in only one crop per year, effectively reducing the arable land by half.

As China continues to grow, demand and supply will struggle to keep up. This would be a problem for any country. For China, the world's biggest consumer and producer, a small deficit can result in huge demand for imports and a big impact on world traded food prices.

India's volatile weather will increasingly impact food prices

India

The world's second-most populous nation, India plays a central role in global food production and consumption. Given the country's size and the income profile (with 28% of its people below the poverty line), food costs and distribution are considered a policy priority. The government purchases around 30% of India's grain production on average for sale at highly subsidised prices under the Public Distribution System (PDS). India is the world's second-largest consumer of wheat, rice, and vegetable oils after China. It is also the largest consumer of sugar.

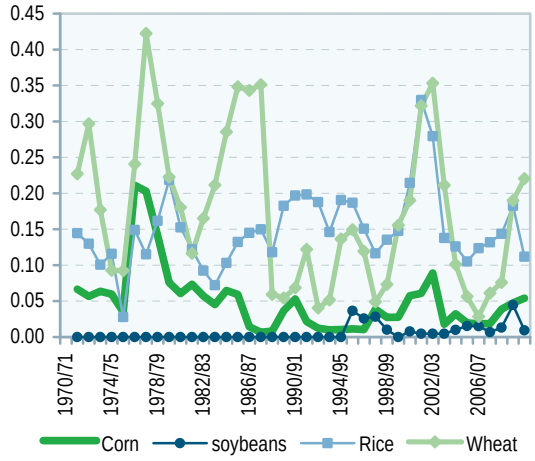
Near-term outlook

Like China, India is typically self-sufficient in grain (rice, wheat and corn). However, the country's crop output tends to be volatile, especially for rain-fed crops like rice (the most widely consumed grain in India), where only 52% of crop has assured irrigation. 2009's poor monsoon rains have highlighted this risk, with official data showing that rains were 25% below normal as of October. Poor rainfall could reduce rice output by as much as 10mt in a single season. Indeed, recent USDA estimates put rice output in India at 84mt this season, resulting in a 5mt deficit. This will need to be countered by a drawdown in stocks, which are forecast to fall by over 40% to 10mt this season. India's total rice ending stocks are currently forecast to be at the lowest level since 2004/05, making it unlikely that India will remove the export restrictions on the popular non-basmati rice which it imposed in April 2008.

On the other hand, India will have a much healthier wheat balance in the current season due to a combination of higher output and higher imports, according to IGC estimates. Wheat is the second-most important grain in India, and improving stocks and a moderately rising stock-to-use ratio suggest that demand pressure on wheat will be moderate.

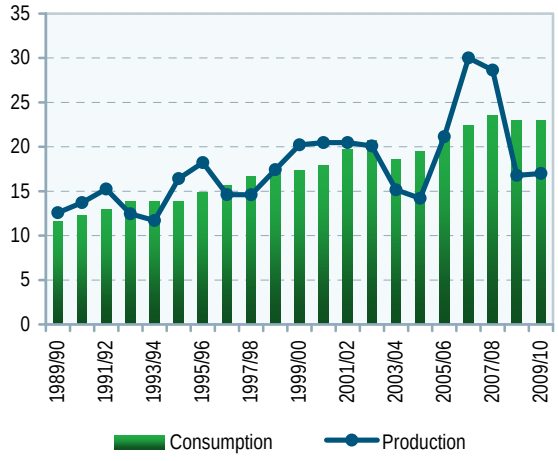
Yet India's role in the current supply/demand imbalance of the sugar sector is a cause of major concern in agricultural commodity markets. India's potentially large sugar import requirement as a result of below-normal rains has pushed sugar prices to near 30-year highs. India's output is expected to reach only 17-18mt this season, while India's sugar consumption is estimated at 23mt. Ongoing uncertainty about India's import requirements in the 2009/10 season has resulted in a delicate balance in world sugar supply. We argue that India's sugar balance will be poor this season, especially given that this will be the second consecutive deficit season. We forecast stock levels to be around 3-4mt, the lowest in 15 years, with the situation remaining tight for the next six months, until better supplies become available from Brazil and India's own planting starts for the 2010/11 season.

Chart VI.3: India's grain stock-to-use ratio



Sources: USDA, SCB Global Research

Chart VI.4: India's sugar balance, mt



Sources: USDA, SCB Global Research

Longer-term outlook

Looking at long-term demand and output trends, India's sugar balance is likely to remain negative, widening from a deficit of 6.2mt in 2010 to 52mt in 2050. This assumes a growth rate of 2% per annum, which is the average annual growth rate in consumption over the past decade, and rapid population growth (with India's total population bypassing China's in 2031). We expect wheat output to remain sufficient until 2017 before turning negative. Even India's rice sufficiency will be severely challenged, and we see a possibility that India will exit the rice export market permanently as early as 2010/11. These estimates do not take account of weather- and climate change-related disruptions, or of growing water shortages due to both the draining of aquifers and reduced glacial melt. Thus, India's ability to meet its long-term food requirements is questionable even under this scenario.

India's ability to meet its growing food needs will also depend largely on land supply and availability. So far, the signs have been good. Aggregate harvested land for corn, rice, wheat, and soybeans has grown by around 16% since 1990 and now accounts for 14% of global harvested area for those crops, compared to 13% in the 1990/91 season. However, harvested area is still relatively volatile from year to year due to climatic conditions, and continuing urbanisation will reduce arable land supply. The potential upside for yields is greater in India than in China and more developed agricultural producers, and emphasis needs to be placed on improving yields through technology and mechanisation. However, social issues have hampered development on this front so far, and these will not disappear overnight.

One important difference between China and India is their current levels of calorie consumption. In China, average per-capita daily food consumption reached 3,040kcal per day in 1997, while in India it was below 2,500kcal. Calorie intake in industrial economies was around 3,400kcal during the same period. This suggests significant scope for increase in India, potentially challenging China's role as the principal engine of growth in global food demand. While cultural differences (India favours vegetarianism) will likely keep India's demand for meat and animal feeds at much lower levels to those seen in China, India's demand for edible oils and grains will remain significant. India also faces a much more serious threat to its food self-

sufficiency than China, so it will almost inevitably become a big force on the world grain markets.

Although we have focussed on China and India, trends in these two Asian giants reflect wider developments across Asia, where changing demographics will test the food system. According to UN estimates, the urban population in the Asia-Pacific region is expected to grow by 45% between 2000 and 2020, with China, Vietnam, Indonesia, and Singapore growing the fastest. Rising per-capita incomes are likely to lead to increased consumption of higher-protein diets and livestock, requiring more grain production. We expect Asia to dominate global demand for feedgrains through to 2050. Moreover, changes in rural/urban population dynamics are likely to pressure arable land supply.

VII. MENA – food insecurity

Water and demographics dominate food issues in MENA

The outlook for the Middle East and North Africa (MENA) region is dominated by two factors: water and demographics. MENA is one of the world's most import-dependent regions when it comes to food. This is due to a shortage of water resources, which makes it difficult to grow water-intensive crops like grains, as well as high demand from a young and growing population. (For more details on the extreme water scarcity faced by much of MENA, see **Special Report, March 2009, 'Water: the real liquidity crisis'**).

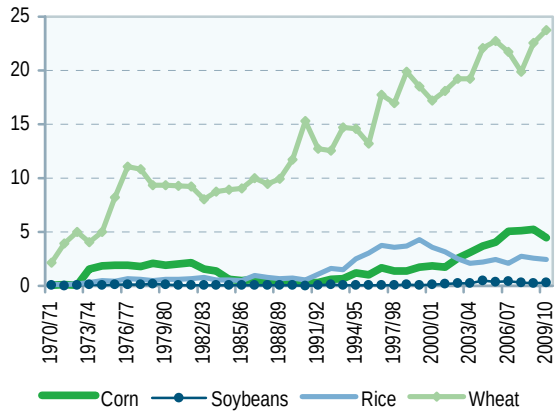
Just as important a factor are the region's rapidly growing populations. An extreme example is Yemen, whose population has risen from about 4 million in 1950 to about 24 million today and is forecast by the UN to grow to as much as 60 million in 2050. At the same time, Yemen's total renewable water resources are already less than $100m^3$ per person per annum – water stress is defined as water resources of less than $1,000m^3$ – which makes for a very uncomfortable equation.

The USDA estimates that MENA will import 71%, 58%, and 39% of its domestic rice, corn, and wheat consumption requirements, respectively, this season. This high level of dependence makes the region vulnerable to global price fluctuations and to changes in trade policies in exporting countries. Wheat is the dominant grain in the region, with 50mt consumed per annum – well ahead of rice, with consumption of only 8mt per annum. In fact, the region is the world's largest per-capita consumer of wheat, most of which is imported from the US, Europe, or the Black Sea region.

Near-term outlook

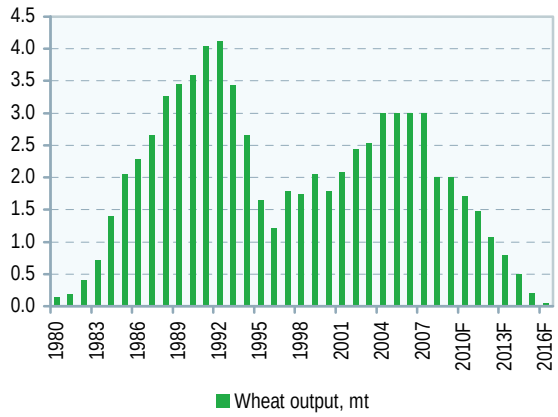
This season's wheat balances look adequate in the Middle East. Output is expected to rise to 36mt from 32mt last season, mainly on account of favourable output in North Africa (Morocco in particular) and in spite of a drop in Saudi Arabia's output as it winds down on a 30-year-old programme aimed at wheat self-sufficiency.

Chart VII.1: MENA grain ending stocks



Sources: USDA, SCB Global Research

Chart VII.2: Saudi wheat output, actual and projected, mt



Sources: USDA, SCB Global Research

Moderately higher rice output, combined with a larger wheat harvest, means that the MENA region is likely to import 5mt less wheat this season than last season. Ending stocks are forecast at 23.7mt, the highest on record and an increase of more than 1mt from last year and 4mt than 2007, when poor harvests pushed grain prices to record highs.

Longer-term outlook

The longer-term outlook for Middle East consumption is driven by rapid population growth and severely restricted water resources. Our projections point to increased reliance on imports to meet food requirements, albeit to varying degrees.

It is theoretically possible for the MENA region to become self-sufficient in wheat by 2030, assuming that per-capita consumption remains flat and output continues to grow at 3% per annum (the average annual growth rate since 2001). However, meeting this target would require slower population growth, much more efficient water use, significant yield enhancement (crop per drop), and a higher share of the region's precious water resources dedicated to food production. Allocating all the water required for sufficient grain production would be detrimental to total GDP if water was diverted from other more economically productive uses. To meet agriculture's needs and to maintain living standards and industrial growth would require a huge commitment to desalination to provide enough water. Until concentrated solar thermal desalination is made commercially viable, such desalination will also rely on the use of fossil fuels, with the ensuing cost and increase in greenhouse gas emissions.

Finally, crops grown in hot, dry conditions require more water, even if water management issues are addressed and efforts are made to irrigate farmland more efficiently. This needs to be weighed against the option of importing virtual water via grain imports.

Besides water scarcity, the other major impediment to increasing food supply in the MENA region is the tight availability of land. We calculate that total harvested area for corn, soybeans, rice, and wheat has remained largely flat since the 1990/91 season at around 28mn ha. Arable land in the MENA region grew by less than 6% between 1961 and 2007, less than the global average of 10% during the period and well below the 45% increase recorded in Africa. It is against this backdrop that public and private investors from the MENA region have been at the forefront of overseas land and farm purchases. This is aimed primarily at improving food security through 'controlling' overseas land supply which dedicates its food output for their region. There are significant political issues arising from this strategy. One issue gained prominence in early 2009, when a large land-lease deal with a foreign company was cited as a key element in the army's removal of the government in Madagascar.

A final noteworthy issue is the MENA region's growth in per-capita consumption of palm oil and soybeans, which has averaged more than 10% per annum since 2001. The Middle East does not produce any palm oil and will therefore have to rely entirely on imports to meet demand. Current soybean output is already barely sufficient to cover consumption, and our model suggests that the region's soybean deficit will widen to 16mt by 2020 from 5mt this season.

MENA currently faces the tough question of how to feed its rapidly growing population while also maintaining living standards. The answer currently seems quite clear: import more food. Saudi Arabia has recognised the flaw in trying to grow wheat domestically rather than importing and is winding down their exorbitant water use, but the whole region faces a further long-term food security risk, as it relies on the proceeds of hydrocarbon sales to buy food.

VII. Conclusions

Global solutions, regional disparities, local problems

In this report, we have looked at the elements driving longer-term demand growth and the constraints to supply growth – including shortage of land, decelerating yield growth, competition from biofuels, water scarcity, and, climate change, which will likely make weather conditions even less predictable than they are today.

We draw the following conclusions:

1) 'Feeding the world' is achievable at a global level, but at a cost which will inevitably mean higher prices.

2) Regional variations in food availability will widen, leading to more cross-border investment in the agricultural sector, the risk of protectionist policies, and heightened food security concerns for net food importers.

3) At a local level, food affordability will become a key focus of fiscal and trade policy across the developing countries. While higher prices have positive implications for farm incomes and investment incentives, they will hinder the drive to improve food security for the poor.

Higher prices, sector growth present opportunities

As far as industry sectors are concerned, there are positive implications for agricultural land owners and producers, as long as they are net food providers. Smaller producers who are net buyers of food – and who tend to be small landholders – will suffer as a higher proportion of their budget is allocated to food.

Other sectors likely to benefit include agricultural equipment suppliers and companies which provide inputs to boost yields, such as fertiliser and seed technology. Increased agricultural trade will provide opportunities for port owners and operators, and for integrated supply chain management companies. Food processors will likely benefit from higher volume and value throughput.

Regional disparities and food insecurity

The striking regional variations in projected food demand and in the capacity to increase output suggest that trade in food commodities will increase. Fears over future availability, and improved returns generated from higher prices, are already driving a trend towards cross-border investment in agricultural land. A sustained increase in agricultural prices is likely to attract private-sector involvement in what is now largely a government-led initiative.

Protectionist trade policies by commodity exporters are a significant risk, as we saw during the escalation of rice prices in 2008, when export restrictions in India and Thailand exacerbated scarcity fears and drove prices even higher. This leaves food-importing countries vulnerable to changes in policy, heightening food insecurity concerns and potentially increasing the risks of social unrest and political instability.

Those countries that will be large food exporters should benefit, all things being equal, especially those with secure water resources and which are less exposed to the downside of climate change. These include Brazil, Canada, US, Thailand and part of Europe.

Disproportionate impact on the poor

The food problem will become as much one of affordability as of availability. Higher food prices will be felt disproportionately by those on low incomes. As Table VIII.1 shows, on average, food comprises 10% of budgets in high-income countries but 50% of budgets in low-income countries. The proportion of staples within the food basket is also higher in lower-income countries, at 70%, compared to 20% for high-income countries. Consequently, a 50% rise in, say, grains prices has a greater impact on low-income household budgets. Assuming a 60% pass-through, food costs as a proportion of income rise by 10ppt to over 60% in low-income countries, but by just 1ppt to about 11% in high-income countries.

Table VIII.1: Impact of higher food prices according to income

	High-income	Low-income food deficit countries
Income	USD 40,000	USD 800
Food expenditure	USD 4,000	USD 400
Food cost as a % of income	10%	50%
Staples as a % of total food spending	20%	70%
Scenario: 50% increase in cost of staples with 60% pass-through to consumers		
New total food costs	USD 4,240	USD 484
Food cost as % of income	10.6%	60.5%

Source: ERS

The risks to low-income groups will present significant challenges to policy makers, in turn raising the likelihood of domestic price controls or other fiscal measures in the economies least able to afford them, and raising the risk of social unrest and political instability.

For countries and companies, the challenge of meeting the increased demand for food will present considerable risks but also great opportunities.

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Disclosures Appendix

Regulatory disclosure

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