



Food Prices Project Report

What caused the food price spike of 2007/08? Lessons for world cereals markets

Steve Wiggins, Sharada Keats & Julia Compton¹

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* Disclaimer: The views presented in this paper are those of the authors and do not necessarily represent the views of the Department for International Development (DFID)

Overseas Development Institute

111 Westminster Bridge Road

London SE1 7JD

UK

Tel: +44 (0)20 7922 0300 Fax: +44 (0)20 7922 0399

www.odi.org.uk

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Key points

The spike in international prices of cereals that took place in 2007/08 can be seen as the outcome of many factors operating over the medium, short and very short term. There is general agreement on most of the causes, including: poor harvests, low cereals stocks, rising oil price, generalised inflation, export bans and restrictions, restocking in tight markets, reduced import tariffs, and depreciation of US dollar.

There is less agreement on three other factors: first, the influence of rising demand from the booming economies of Asia —probably not a cause; second, the diversion of maize into ethanol production in the US — responsible for perhaps 30% of the rise in prices; and, third, the role of speculation in futures markets for maize and wheat — controversial and difficult to prove.

This combination of multiple causes can be seen as an unusual event — ‘a perfect storm’ — in which it is difficult to judge the weight of any given cause. Moreover, maize, rice and wheat prices responded differentially to these factors.

While these factors are unlikely to combine again, other trends, particularly higher oil prices, increasing scarcity of irrigation water and climate change mean that cereals prices will be higher than in the past and that spikes could be more common.

Policy makers thus need to:

- Ensure that cereals production keeps pace with increasing demand, through adequate public investment and incentives to farmers;
- Improve information on grain stocks so that traders and governments have warning of dangerously low stock-to-use ratios;
- Reconsider biofuel policies and particularly mandatory quantitative targets; and, possibly,
- Work towards understandings in international trade deals that export restrictions will only be applied in emergencies, and preferably with some warning to trading partners.

Climate change will make harvests more variable. Hence stock-to-use ratios to smooth consumption may need to rise; and more trade will be needed to even out variations across the globe.

Why this brief?

Ever since cereals prices on world markets began to rise rapidly in 2007, there have been attempts to explain the reasons why. By now there have been sufficient analyses to identify what is reasonably known and agreed, and what remains in doubt.

Understanding the causes of the price spike matters if the options for either preventing or mitigating future such events are to be assessed. This paper summarises what is known about the causes of the price spike, sets out three areas of controversy and suggests the policy implications that follow.²

The causes of the 2007/2008 food price spike

Most analyses³ agree on a common list of likely contributing factors, although not necessarily on their importance. They include:

- **Supply side:** poor harvests especially of wheat, lower grain stocks, and rise in oil price;
- **Demand side:** widespread inflation resulting from rapid growth of the world economy;
- **Policies:** export bans and restrictions, restocking in tight markets and reduced import tariffs; and
- **Financial:** depreciation of the US dollar.

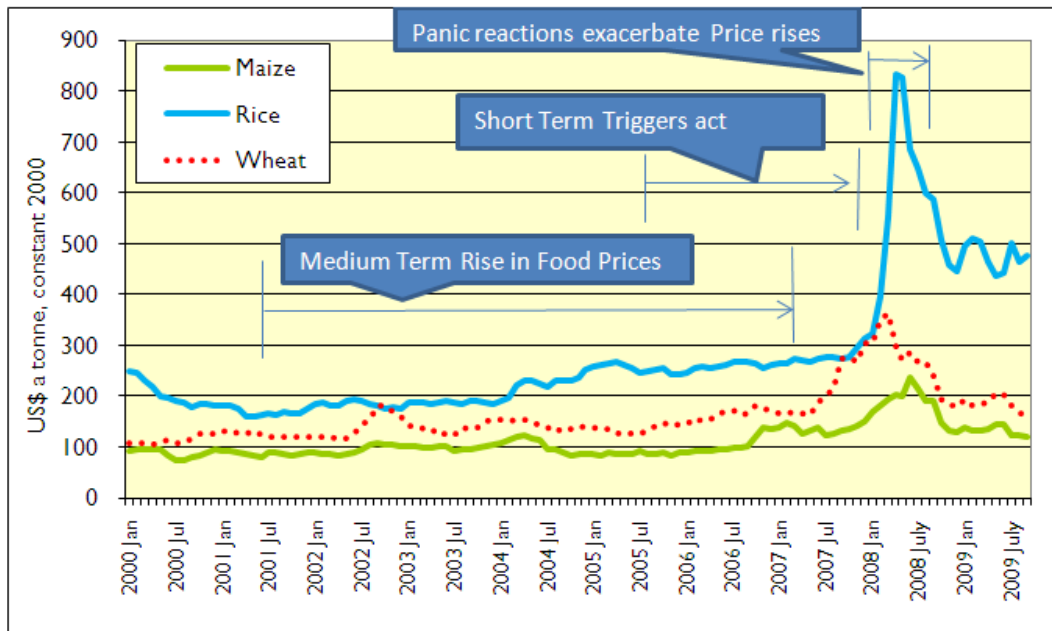
In addition, another three causes have been advanced, but their role is contested: diversion of grains to distillation for biofuels; rising demand in China, India and other rapidly growing economies; and, speculation on futures markets. These will be examined later in this brief.

To understand how the price spike developed, it is useful to see these factors as they arose through time. The evolution of the price spike can be seen as a *combination of factors* applying over the medium term from the early 2000s to late 2006, *triggers* operating in the short-term from 2006 to the peak of the spike in early 2008, and, in the very short term from mid 2007, *reactions* to the initial price rise that exacerbated price increases. Figure A illustrates the time scales and the evolution of the price spike.

² A subsequent brief will assess policy options in more detail.

³ The main sources drawn on comprise: Abbot & Borot 2009, Abbot, Hurt & Tyner 2008, Collins 2008, Gilbert 2008, Mitchell 2008, Robles, Torero & von Braun 2009, Timmer 2008, and Trostle 2008a & 2008b.

Figure A: Evolution of the price spike. Price of three main cereals on world markets in constant terms



Source: IMF commodity prices, monthly, deflated by the US GDP deflator

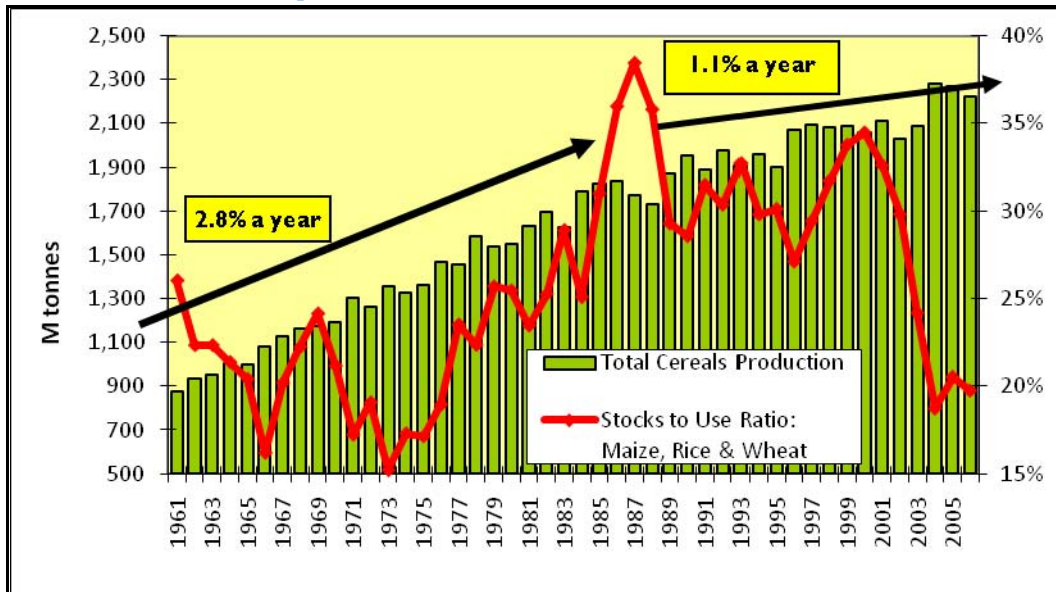
Taking these three periods in turn, *medium term factors* include:

- The *slow-down in growth of production of cereals* since the mid-1980s in the face of rising demand. From the early 1960s to the early 1980s, world cereals production grew strongly at an average of 2.8% a year, comfortably ahead of population growth. Subsequently, however, growth has slowed markedly to an average of 1.1% a year. Indeed, in the first four marketing years of the new century, global cereals consumption exceeded production;
- Slower growth of production contributed, along with decisions to hold smaller public stocks of grain in the USA, Europe, China, and other developing countries, to a *decline in stocks of cereals* from 2000 onwards. For the three main grains, worldwide, end-of-season stocks as a ratio of use fell from more than 34% in the late 1990s to under 20% by 2005.

Lower stocks in themselves do not, of course, cause prices to rise. When they are low, however, any sudden and unanticipated fall in supply or rise in demand cannot be accommodated by release of stocks so adjustment falls largely on prices. Conventional wisdom is that 'on a world basis, a stocks/use ratio for wheat under 20% has typically led to strong price advances. For corn [maize], the comparable number appears to be under 12%.'⁴ All price spikes seen since the early 1970s have been associated with low stocks;

⁴ The 'stocks-to-use ratio' indicates the level of carryover stock for any given commodity as a percentage of the total demand or use. http://futures.tradingcharts.com/learning/stocks_to_use.html

Figure B: Growth of cereals production, 1961 to 2006



Source: FAOSTAT data

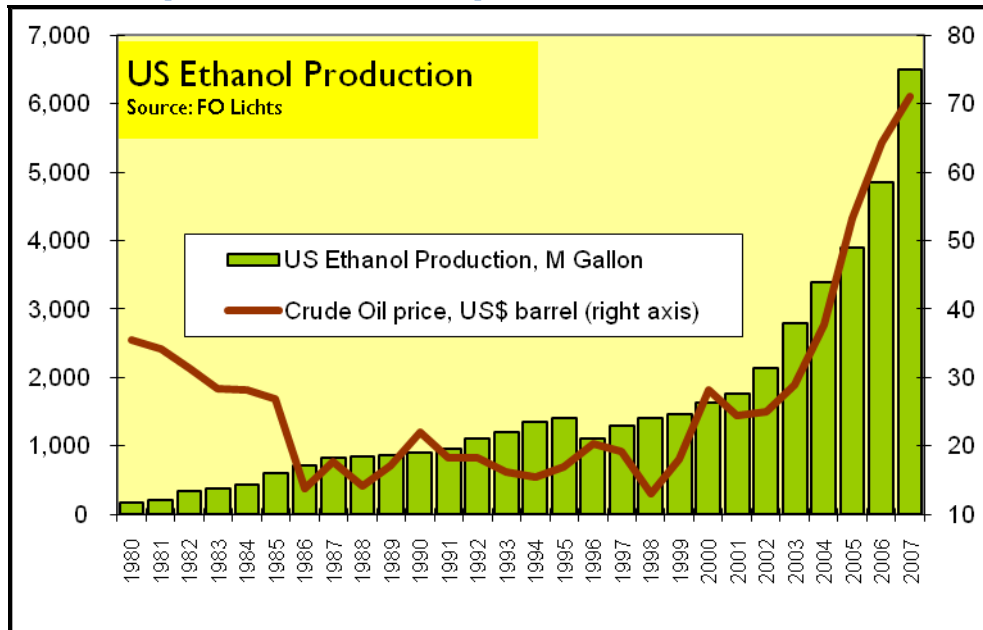
- **Rising oil prices** — from less than US\$20 a barrel in late 2001 to more than US\$130 a barrel in July 2008 — pushed up costs of diesel and nitrogenous fertiliser, thereby raising costs of production on farms as well as transportation of cereals.

Moreover, as oil prices rise, the economic attraction of using cereals to distil ethanol increases.⁵ There is a close correspondence between the price of crude oil and US ethanol production — see Figure C - with both oil prices and ethanol production increasing sharply from 2003 onwards. It was not just the price of oil that encouraged ethanol distillation in the US and biodiesel fermentation in the EU: the public mandates for replacement of transport fuels, accompanied by subsidies and other inducements, also played a role as will be set out below.

While some of the maize distilled in the US came from additional production, some was diverted from previous use as food and feed. Moreover, additional land used to produce maize tended to displace wheat and soybean production, thereby reducing their supply. The overall effect was to push up prices of maize, wheat and soybeans;

⁵ As a rule of thumb, when oil prices rise above US\$60 to US\$70 a barrel, ethanol from grain often becomes commercially attractive. More strictly, it is the ratio of the oil price to that of feedstock. Of particular interest here is the ratio of oil prices to those of maize. A spike in grains prices then tends to reduce the demand for ethanol, since the rising cost of grain as feedstock can offset the incentive of high oil prices.

Figure C: US ethanol production and crude oil prices, 1980 to 2007



- **Decline in the value of the US dollar** against other major currencies meant that some importers, particularly in Asia, found they could afford to bid more for cereals in dollar prices and hence tended to push up prices. The increase in food prices denominated in other trading currencies, such as the Euro, was less;
- **Conditions in the world economy** that saw rapid economic growth with commensurate, although not equal, increases in demand for most commodities, accompanied by expansion of the money supply that permitted general inflation across commodities. The metals price index, for example, more than trebled between late 2001 and mid-2007; while the food price index rose by 87%; and, controversially,
- Major **investments by index funds in agricultural futures markets** in the USA that, some argue, may have affected spot market prices (see below).

These trends pushed up cereals prices from 2002 onwards, but by modest amounts. Prices in real (US dollar) terms rose from 2002 to late 2006 by 16% for maize, 49% for rice, and 35% for wheat.

Those studying the markets, including grain traders, were aware that as stock-to-use ratios fell, the market was vulnerable to short-term shocks such as crop failures. What they did not know, however, was when those shocks would happen. In this case the **short-run triggers** that set off rapid inflation of grain prices were:

- **Low Wheat harvests** in Australia and Ukraine in 2006 and 2007, so that world production fell from in 626Mt in 2004/05 to 621Mt in 2005/06 and to 596Mt in 2006/07 (about a 4% decrease over the two years); and,

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- Demand for maize in the US, the world's main exporter, was stimulated by *switching maize to ethanol production*, thanks in part to the 2005 Energy Act in the US with its mandatory targets for biofuels production and its discouragement of MTBE (methyl tert-butyl ether) as a petroleum additive that led to its replacement by ethanol. Combined with the high oil prices, this boosted ethanol production so that by 2007 more than 30% of the maize crop in the US was distilled.

Once prices started to rise rapidly in 2007, alarm spread among governments, traders and consumers producing *reactions* that accelerated still further the price rises:

- *Export bans and other restrictions* were applied to wheat and probably most damagingly to rice. For wheat, amongst major exporters, Kazakhstan banned exports in April 2007 until mid 2008; Ukraine imposed quotas on exports in July 2007 before relaxing them in October 2007, and removing them in May 2008; Russia imposed taxes on wheat in November 2007, raised them in March 2008 before withdrawing them in July 2008; and Argentina also restricted its wheat exports. USDA calculates that wheat prices may have risen by 20% in response to export restrictions (The Economist, 27 March 2008).

Amongst the main exporters of rice, Vietnam banned exports in September 2007, followed shortly thereafter by India that banned exports of non-basmati rice in November 2007. Egypt also stopped its exports. Given that less than 7% of global production of rice is traded, and the importance of Indian exports, the result was panic on rice markets as importing countries scrambled to assure supplies. This led to...

- *Restocking by countries* determined to ensure supplies in the teeth of a tight market. This applied above all to rice. For example, in marketing year 2007/08, of the main rice importers, the Philippines imported 71% more than its average imports of rice in the five years from 2001/02 to 2005/06, while Malaysia raised imports over the annual previous average by 54%, Iran by 36%, the EU by 31%, and Saudi Arabia by 15%. Bangladesh increased imports by 134% over the five-year average, but that was largely in response to a domestic harvest failure;
- On top of this, and again mainly in rice markets, there may well have been additional *stocking by consumers and traders* worried either that prices would be higher still in the future or that high prices heralded imminent shortages. In the Philippines, for example, the press reported extra buying in supermarkets; and,
- *Reduction of import tariffs* was a common response in net food importing countries that allowed some consumers to maintain consumption in the face of rising prices that might otherwise have discouraged consumption or caused them to switch to some other staple.

Disputed causes

While there is general agreement on most of the causes, three elements have been contested:

Increased demand for cereals in booming Asian economies. Has there been a surge in cereals consumption by the rapidly-growing and large economies of Asia that has outstripped production? It seems not. Cereals consumption in China and India, for example, has grown quite slowly: from 1990/91 to 2007/08, by 25% in China and by 40% in India, that is, at average growth rates of 1.1% and 1.6% a year, and with little sign of any acceleration during this period.⁶ Moreover, both countries import very little grain:⁷ their demand is met very largely by domestic production.

*The importance of expanded production of biofuels.*⁸ Estimates of the contribution of increased demand for biofuels, in particular ethanol in the USA,⁹ to the price spike vary from a negligible 3% to an overwhelming 75%. The former estimate was derived by estimating the effect on maize prices, in which increased ethanol production is reckoned to have contributed about one third of the maize price increase, and then dividing this by the contribution of maize to an index of food prices in general, not just those of cereals. This seems somewhat contrived since most of the concern is over staples prices, not all food prices. The latter estimate also probably exaggerates: although often quoted, it seems a misreading of a World Bank report (Mitchell 2008) that attributes 70–75% of the cause of the price spike to biofuels ‘and the related consequences of low grain stocks, large land use shifts, speculative activity and export bans’ — so not just biofuels, but several other potentially important factors.¹⁰

A better estimate comes from IFPRI (Rosegrant 2008) that modelled the impact of the acceleration in the growth of ethanol production on grain prices, by holding that growth to the rate seen from 1990 to 2000. Increased production of biofuels over and above the previous trend then causes 39% of the (real) increase

⁶ In the five year period 2002/03 to 2007/08, China’s consumption of grains rose by 5% and India’s by 9%.

⁷ Even when including the indirect grain imports when countries such as China import meat that has been produced largely by feeding grain to pigs and poultry.

⁸ There is also some debate over the extent to which the surge in US ethanol production responds to higher oil prices, and how much to subsidies and official mandates. Modelling suggests that all of the increased production was caused by a combination of oil prices and changed policies on fuel additives. (Hertel et al. 2008) That said, it would overstate the position to imagine that the strong encouragements from government to invest in ethanol production have had no effect.

⁹ European expansion of biofuels production has been mainly of biodiesel. This affects oilseeds markets, but not those of cereals.

¹⁰ The method used is questionable. It proposes that all of the price effects that cannot be attributed entirely to one or other factor must therefore be attributable to the remaining factor or factors. If factors applied additively, this might be fair; but it does not apply if the various factors affect the price multiplicatively, as well they may in this case. Abbot et al 2008 consider that trying to weight precisely the role of the several factors that led to the price spike is pointless: ‘There is no doubt that the causes of the current agricultural commodity price increases are complex. We make no attempt to derive percentages attributable to the many disparate causes, and, indeed, think it impossible to do so.’

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in maize prices. It also accounts for 21% of higher rice and 22% of increased wheat prices.¹¹ For cereals prices overall, 30% of the spike can be attributed to biofuels.

Our conclusion is that while expanded biofuels played a substantial role in pushing up maize prices, it is unlikely to have been the main factor.

Investment ('speculation') in cereals futures. Since the early 2000s, index funds, apparently seeking better returns than those to be had on stocks and property, have increased markedly their investments in commodities futures on the main US exchange in Chicago, including agricultural commodities and cereals. For example, the quantity of maize futures held by index funds on 12 March 2008 was 60.4Mt, up from 6.1Mt just over five years before on 01 January 2003; while for wheat futures, the increase was from 4.5Mt to 30.9Mt. Increased interest by index funds has been accompanied by rising futures prices. For example, from March 2003 to March 2008, the futures prices for maize and wheat rose by 134% and 314% respectively. This is then argued to have contributed to the price spike: over the same period spot market prices for maize and wheat rose by 223% and 310%. [Masters' testimony data 2008]

There are several objections to this plausible line of argument:

- Much of the increase in index positions on grain futures came before the period of the price spike. Indeed, between the first quarters of 2006 and 2008, increases in long positions taken by (commercial) hedgers on maize futures considerably exceeded those of index fund moves (Irwin 2009);
- Statistical tests, using Granger causality models, of the relation between index investments and spot prices of grains for most periods and agricultural commodities fail to show any relation — see, for example Gilbert 2008, Robles et al. 2009, Sanders et al. 2008;
- Not all the agricultural commodities into which index funds have invested have seen large increases in prices, while some farm products for which there is little or no futures market did see price spikes. Of the main grains, rice barely has a futures market and yet the price spike for rice was by far the largest; and, most damning of all,
- What is the link from futures to spot market prices? If futures prices were to affect spot prices, it would be through speculators buying up physical produce from the markets and storing ('hoarding') this in anticipation of profiting later. There is simply no evidence that this took place. Index funds neither operate nor rent grain silos.

This has not stopped the US Senate, however, from concluding that index trading in farm futures did help drive up prices; drawing trenchant rebuttals from some US agricultural economists. But then again scapegoating speculators has a long history.

¹¹ Other (computable general equilibrium) models show much less impact on wheat prices and no effect on rice prices (see Wiggins et al. 2008)

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Three things stand out from a review of the causes:

- It is difficult to judge the relative weights of the factors, since they acted in combination. The argument that the removal of one or other condition would have prevented the spike does not mean that the condition in question was the overwhelming cause of the spike, since the same would apply to several other conditions;
- The spikes seen in maize, rice and wheat prices responded in differing degrees to the various factors. This is most clear for rice, where neither of the two short-run triggers applied to the crop, and where most of the effect probably came from panic reactions to rising prices;
- With so many factors combining, the spike can be seen as an unusual event — ‘a perfect storm’ in the words of Josette Sheeran of WFP, and hence unlikely to arise frequently. That said, as the next section will explain, changes in the future may make spikes more likely, so this is not an argument for complacency.

Policy implications

In looking for ways to avert or mitigate future spikes, causes can be categorised along a spectrum from matters of chance, to matters that are more susceptible to policy. In between are causes that result from complex systems where intervention can produce unexpected and unwelcome results. Table A sets out the causes along this spectrum.

Table A: Causes of the spike: from chance to flawed policy

Cause	Chance or policy?	Remedy
Poor harvests	Largely chance	[Irrigation, but costly]
Rising oil price	Complex outcomes of economies.	Remedies are unclear and uncertain, and apply in the medium run — e.g. investment in exploration, switching to renewable fuels, more precise/efficient use of farm inputs.
Generalised inflation		Macro-economic policies could remedy. But such policies are driven by considerations that take political precedence over outcomes in commodity markets.
Depreciation of dollar		
Consumer stocking	Household decisions	Very difficult to prevent alarmed consumers from restocking, unless drastic measures such as rationing are introduced
Medium-term slow-down in growth of cereals production	Farmer decisions influenced by public policy and markets	Invest in public goods for agricultural growth, remove market and/or state failures that impede private investment and innovation in agriculture.
<i>Index fund investment in futures of agricultural commodities</i>	<i>Investor decisions</i>	<i>Control futures markets, allow only commercial traders to participate.</i> <i>Use public funds to counter apparent bubbles in futures prices by selling short options</i> <i>Support moves to improve transparency of transactions on these markets</i>
Falling stocks	Partly government policy	Rebuild public stocks at national, regional or international levels. Provide more information on stocks. Improve transparency of government policies surrounding stock holding/release/importing and encourage private sector involvement
Biofuel policies, esp. 2005 US Energy Act	Government policy	Change policies, reduce mandates or introduce moratoria in times of pressure on food markets
Export bans		Simple to reverse, but politically difficult to prevent when circumstances press. Interests of domestic consumers are difficult to ignore.
Restocking in tight markets		
Reduced import tariffs		

NB: Index fund investments in italics since their role in forming price spikes is contested.

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Can food price spikes be avoided in future? The unusual combination of events in 2007/08 might suggest so. But the future is likely to see changes that increase the risks, in particular:

- *Increased oil prices* as and when peak oil is reached. Higher oil prices will push up costs of Nitrogen fertiliser, diesel for farm machinery and transport of cereals;
- *Increasing water scarcity* in areas where copious use of water for irrigation conflicts with rising demands from industry and human use in fast-growing and urbanising economies; and,
- *Climate change* that will probably see rainfall belts and temperatures change, the loss of some valuable coastal lands to incursions by high tides, changed incidence of pests and diseases, and more variable climate with more frequent extreme weather events.

Higher agricultural prices, perhaps in the range of 10–30%, may inevitably result from these factors. Price spikes with increases several times more, however, are far from inevitable. To avoid them, based on the experience of 2007/08 and future likely developments, policy-makers need to consider the following points:

- Ensuring that cereals production keeps pace with increasing demand, through adequate investment in the public goods that support farmers and especially agricultural research and extension, and by removing policies that reduce incentives to farmers;
- Improving information on grain stocks (and on production and use) so traders and governments have forewarning of dangerously low stock-to-use ratios and otherwise are better informed when taking decisions;
- Given that future harvests may well be more variable as climate change brings more extreme weather, stock-to-use ratios required to smooth consumption may need to rise, and more trade may be needed to even out variations across the globe;
- Biofuel policies and particularly mandatory quantitative targets that lock production in and prevent cereals systems adjusting to economic circumstances may need to be reconsidered; and, possibly,
- Agreements in international trade deals that export restrictions will only be applied in emergencies, and preferably with some warning to trading partners, need to be sought.

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