

**OECD-FAO
Agricultural Outlook
2009-2018**



2009

**OECD-FAO
AGRICULTURAL OUTLOOK
2009-2018**

HIGHLIGHTS

- **The Outlook in Brief**
- *Chapter 1. Overview*
- *Chapter 2. How Resilient is Agriculture to the Global Economic Crisis?*
- *Chapter 3. Can Agriculture Meet the Growing Demand for Food*
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Foreword

The annual Agricultural Outlook report is prepared jointly by the Organisation for Economic Co-operation and Development (OECD) and the Food and Agriculture Organization (FAO) of the United Nations. The projections and assessments provided in this report are the result of close co-operation with national experts in OECD and some non-member countries, reflecting the combined knowledge and expertise of this wide group of collaborators. A jointly developed modelling system, based on the OECD's Aglink and FAO's Cosimo models, facilitates consistency in the projections. The fully documented outlook database, including historical data and projections, is available through the OECD-FAO joint internet site www.agri-outlook.org.

This report covers biofuels, cereals, oilseeds, sugar, meats, and dairy products over the 2009-18 period. The market assessments are based on a set of underlying assumptions regarding macroeconomic factors, agricultural and trade policies and production technologies. They also assume average weather conditions and long-term productivity trends. The *Agricultural Outlook* presents a consistent view on the evolution of global agricultural markets over the next decade and provides a baseline for further analysis of alternative economic or policy assumptions.

In 2009, agricultural markets are characterised by a reduction in commodity prices following their rapid rise over the 2006-08 period. This report examines the general and commodity-specific factors behind the price declines. There is also a discussion on the evolution of retail food prices which have come down but not as quickly as international commodity prices, and with considerable regional variation. Looking forward, real commodity prices over the 2009-18 period are projected to remain at, or above, the 1997-2006 average. An expected economic recovery, renewed food demand growth from developing countries and the emerging biofuel markets are the key drivers underpinning agricultural commodity prices and markets over the medium term.

This year's Outlook is set against a backdrop of unprecedented financial turmoil and rapidly deteriorating global economic prospects. With macroeconomic conditions changing so quickly, the standard baseline projections are complemented with a scenario analysis of revised short-term GDP prospects and alternative GDP recovery paths. A sensitivity analysis of commodity markets to crude oil prices and a survey of the impact of the economic crisis on various actors in the agri-food chain also contribute to the report's timely assessment of the resiliency of the sector to the global economic crisis.

The issue of food security is high on the political agenda as evidenced by the number of recent high-level summits, including the first ever G8 Agriculture Ministerial in April 2009. Much of the discussion is about the capacity of the agricultural sector to meet the rising demand for food. Is there more land that can be brought into production? Can existing agriculture be more productive while becoming more environmentally sustainable? Will there be enough water? What will be the effects of climate change? This report provides a brief overview of several critical factors: land availability, productivity gains, water usage and climate change.

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Acronyms and abbreviations

ACP	African, Caribbean and Pacific countries
AMAD	Agricultural Market Access Database
AUSFTA	Australia and United States Free Trade Agreement
AI	Avian Influenza
BNGY	Billion gallons per year
BNLY	Billion litres per year
BSE	Bovine Spongiform Encephalopathy
Bt	Billion tonnes
BTL	Biomass to liquid
CAFTA	Central American Free Trade Agreement
CAP	Common Agricultural Policy (EU)
CCC	Commodity Credit Corporation
CET	Common External Tariff
CIS	Commonwealth of Independent States
CPI	Consumer Price Index
COOL	Country of Origin Labelling
CRP	Conservation Reserve Program of the United States
CMO	Common Market Organisation for sugar (EU)
CO ₂	Carbon dioxide
Cts/lb	Cents per pound
Cwe	Carcass weight equivalent
DBES	Date-based Export Scheme
DDA	Doha Development Agenda
DDG	Dried Distiller's Grains
Dw	Dressed weight
EBA	Everything-But-Arms Initiative (EU)
ECOWAP	West Africa Regional Agricultural Policy
ECOWAS	Economic Community of West African States
EISA Act	Energy Independence and Security Act of 2007 (US)
EPAs	Economic Partnership Agreements (between EU and ACP countries)
ERS	Economic Research Service of the US Department for Agriculture
Est	Estimate
E85	Blends of biofuel in transport fuel that represent 85% of the fuel volume
EU	European Union
EU-15	Fifteen member states of the European Union
EU-10	Ten new member states of the European Union from May 2004
EU-27	Twenty seven member states of the European Union (including Bulgaria and Romania from 2007)
FAO	Food and Agriculture Organization of the United Nations
FMD	Foot and Mouth Disease
FOB	Free on board (export price)
FR	Federal Reserve (US central bank)
FSRI ACT	Farm Security and Rural Investment Act (US) of 2002
FCE Act	Food, Conservation and Energy Act of 2008 US Farm Bill
FTA	Free Trade Agreement
GDP	Gross Domestic Product
G-10	Group of 10 countries (see Glossary)
G-20	Group of 20 developing countries (see Glossary)
GDPD	Gross Domestic Product Deflator
GHG	Green House Gases
GLB	Gross land balances
GMO	Genetically modified organism
HFCS	High Fructose Corn Syrup

HS	Harmonised Commodity Description and Coding System
IEA	International Energy Agency
iLUC	Indirect land-use change
IPCC	Intergovernmental Panel on Climate Change
Kt	Thousand tonnes
LAC	Latin America and the Caribbean
La Niña	Climatic condition associated with temperature of major sea currents
LDC's	Least Developed Countries
LICONSA	Leche Industrializada
Lw	Live weight
MCI	Multiple cropping index
MERCOSUR	Common Market of the South
MFN	Most Favoured Nation
Mha	Million hectares
MPS	Market Price Support
Mt	Million tonnes
MTBE	Methyl Tertiary Butyl Ether
NAFTA	North American Free Trade Agreement
NLB	Net land balances
OECD	Organisation for Economic Co-operation and Development
OIE	World Organisation for Animal Health
PCE	Private Consumption Expenditure
PIK	Payment in kind programme (US)
PROCAMPO	Mexican Farmers Direct Support Programme
PPP	Purchasing Power Parity
PRRS	Porcine Reproductive and Respiratory Syndrome
PSE	Producer Support Estimate
Pw	Product weight
R&D	Research and Development
RED	Renewable Energy Directive in the EU
Rse	Raw sugar equivalent
Rtc	Ready to cook
RFS	Renewable Fuels Standard in the US, which is part of the Energy Policy Act of 2005
Rwt	Retail weight
SFP	Single Farm Payment scheme (EU)
SMP	Skim milk powder
SPS	Sanitary and Phytosanitary measures
STRV	Short Tons Raw Value
t	Tonnes
t/ha	Tonnes/hectare
TFP	Total factor productivity
TRQ	Tariff rate quota
UK	United Kingdom
UN	The United Nations
URAA	Uruguay Round Agreement on Agriculture
UNCTAD	United Nations Conference on Trade and Development
US	United States of America
USDA	United States Department of Agriculture
VAT	Value added tax
v-CJD	New Creutzfeld-Jakob-Disease
WAEMU	West African Economic and Monetary Union
WMP	Whole milk powder
WTO	World Trade Organisation

Symbols

AUD	Dollars (Australia)
ARS	Pesos (Argentina)
Bn	Billion
BRL	Real (Brazil)
CAD	Dollars (Canada)
CNY	Yuan (China)
EUR	Euro (Europe)
gal	Gallons
Ha	Hectare
hl	Hectolitre
INR	Indian rupees
KRW	Korean won
lb	Pound
Mn	Million
MXN	Mexican pesos
NZD	Dollars (New Zealand)
p.a	Per annum
RUR	Ruble (Russia)
THB	Thai baht
USD	Dollars (United States)
ZAR	South African rand

Box 1. THE OUTLOOK IN BRIEF

- The macroeconomic environment underlying this medium-term outlook, based on the OECD's and World Bank's medium term economic projections from December 2008, continues to evolve rapidly due to the ongoing financial and economic crisis. Because of the turmoil in the economic environment the baseline projections must be interpreted with caution. The possible impacts of this deteriorating economic crisis on the baseline projections have been analyzed both qualitatively and quantitatively within the present report, although an assessment of the full impact of the current global credit crunch and economic contraction on agricultural markets goes beyond the scope of this Outlook.
- A stronger than expected agricultural commodity supply response last year, particularly in developed countries, and much lower oil prices has resulted in significantly lower commodity prices from 2007-08 highs. Continued weakness in the general economy will further dampen commodity prices over the next 2-3 years, which should then strengthen with economic recovery.
- The situation varies by commodity but average prices in real terms (adjusted for inflation) for the next 10 years are still projected at or above the levels of the decade prior to the 2007-08 peaks. Average crop prices are projected to be 10-20% higher in real terms relative to 1997-2006, while for vegetable oils real prices are expected to be more than 30% higher.
- Meat prices in real terms are not expected to surpass the 1997-2006 average, while reduced consumer incomes in the beginning of the projection period will tend to encourage substitution to cheaper meats, favouring poultry over beef. Average dairy prices in real terms are likely to be slightly higher in 2009-18 relative to 1997-2006, driven up by rising energy and vegetable oil prices, with a 12% increase in average butter prices being the most notable.
- Despite the significant impact of the global financial crisis and economic downturn on all sectors of the economy, agriculture is expected to be relatively better off, as a result of the recent period of relatively high incomes and a relatively income-inelastic demand for food.
- Global economic prospects are now more pessimistic than earlier in the year when this outlook was prepared. In response, the outlook includes a special focus on the resiliency of agriculture to economic recession. The analysis suggests that the reduction in agricultural prices, production and consumption, associated with lower incomes is likely to be moderate, as long as economic recovery begins within 2-3 years.
- This special focus provides an assessment of an even deeper and more prolonged recession with lower GDP and incomes than in the outlook baseline. Demand for higher cost livestock products, such as beef, pork and dairy, would be the most seriously affected. Beef prices would be about 9% below those projected in the baseline. The reductions in crop and biofuel prices associated with the lower GDP scenarios were only about one-half those for livestock products. Among cereals, maize prices were the most responsive to lower GDP, reflecting its use primarily as a feed ingredient rather than a biofuel feedstock.
- The special focus also includes a survey of the impact of the financial market turmoil and economic crisis on agri-businesses, from input suppliers to retail. The sector seems to be weathering the recession fairly well to date. However, downstream sectors are experiencing difficulties in access to credit. Trade finance constraints are having significant impacts on firms and should these tight credit markets persist, firm viability could be in peril. Access to credit was viewed as the key issue, particularly by smaller agri-food firms in both OECD and non-OECD countries surveyed.
- The special focus also examines the sensitivity of agricultural prices to crude oil prices. Energy and agricultural prices have become much more interdependent with industrialised farming, more processing and increased transport, as well as the emergence of the biofuels industry (particularly for maize, oilseeds and sugar feedstocks). Crude oil prices are highly volatile and some projections are well above those used in this outlook.
- The crude oil price over the medium-term assumed for the baseline is about 60% higher than the 1997-2006 average in real terms, moderately increasing to USD 70 per barrel by the end of projection period. If crude oil prices increased to the USD 90 to USD 100+ per barrel level used in last year's *Outlook*, agricultural prices would be significantly higher; with the largest impact on crops, driven mainly by reduced crop production with higher input costs, but also increased feedstock demand for biofuels.

- Biofuel markets increasingly depend on government mandated use, but prospects remain uncertain, due to such unpredictable factors as the future trend in crude oil prices, changes in policy interventions and developments in second-generation technology. Biofuels will struggle to compete with relatively low fossil fuel prices as long as crude oil prices remain in the USD 60-70 range assumed for most of this Outlook, although biofuel support policies underpin ethanol and biodiesel prices and production. A projected rapid expansion of biofuel production to meet mandated use will continue to have inflating price impacts for such feedstocks as wheat, maize, oilseeds and sugar.
- Once economic recovery begins most of the growth in agricultural production and consumption will continue to come from developing countries. This is particularly evident for livestock products where the primary drivers are income and population growth, with a trend towards higher animal protein diets and continuing urbanisation.
- For almost all commodities, projected growth in imports and exports of developing countries exceeds that of the OECD area. Continued expanding South-South trade is a key feature of the *Outlook*. Nevertheless, OECD countries will continue to dominate exports of wheat, coarse grains and all dairy products.
- A key focus of last year's *Outlook* was the large hike in food prices associated with rising commodity prices. While commodity prices have since declined, food prices have remained high in many countries. Still, food inflation has come down. Over the 3 and 6 month periods ending February 2009, the decline in food price indices in many countries has been accelerating.
- According to recent FAO work using longer term population and income projections, global food production needs to increase more than 40% by 2030 and 70% by 2050, compared to average 2005-07 levels. There is substantial additional land available for use in agriculture. Some 1.6 billion ha could be added to the current 1.4 billion ha of cropland. Over half of the additionally available land is found in Africa and in Latin America. These regions account for most of the available land that has the highest suitability class for rain-fed crop production. But historical expansion of arable land has been slow, and bringing more marginal land into production can involve considerable investment and lower average yields, while possibly incurring social and environmental costs.
- Crop and livestock productivity continues to rise at long term trend rates, at least in the most productive areas, and there is considerable potential for further increases over the next 10-20 years. To capitalize on this potential requires development and adaptation of new technologies but growth in public agricultural research expenditures is slowing. In many regions like Central and Eastern Europe and Sub-Saharan Africa, productivity can be significantly increased using existing technologies with better access to inputs, infrastructure development and extension services.
- Agriculture accounts for over 40% of water use in OECD countries and use has been growing. Irrigation accounts for 99% of this use and major developing countries like China and India have large areas under irrigation. The FAO projects a substantial slowdown in expansion of area under irrigation, and future agricultural production will be increasingly conditioned by water availability.
- Climate change is an important variable in future production possibilities as well. It will clearly add to the risks of water stress as well as the incidence and severity of floods, and likely shift production frontiers.
- Behind this fairly positive outlook for agricultural commodity markets lies a more disturbing story about hunger and food insecurity for some one billion people. Food security is not only about solving the urgency in the short-term; it is also about addressing the longer term issues of poverty alleviation and economic growth. Greater investment in agriculture, more effective development aid and reforms to trade and domestic policies are all part of the solution.

CHAPTER 1

OVERVIEW

Preparation of the 2009 *OECD-FAO Agricultural Outlook* report, in this year of unprecedented global economic turmoil, has been particularly difficult and requires additional caution on the part of readers when interpreting the results as the macroeconomic situation is constantly unfolding.

The outlook baseline incorporates a serious global economic slowdown but reflects a less profound recession than that foreseen by major economic institutions in late March 2009. The macroeconomic assumptions in the baseline have GDP contracting in many regions of the world and, in the OECD area as a whole, with a resumption of economic growth projected for 2010; higher growth then continues throughout the remainder of the projection period. A special assessment of certain aspects of the impact of the unfolding economic crisis on agriculture is provided in Chapter 2.

World markets at a glance

Such was the force of the 2008 high food price shock which reverberated across countries, especially in the economically vulnerable ones, that some even raised questions about the future reliability of international markets to deliver sufficient quantities of food at affordable prices. Since then agricultural commodity prices have fallen substantially, but food prices in a number of developing countries have remained high well into 2009.

Without doubt, the influence of the macroeconomic factors in determining the contours of the world agricultural landscape has never been so profound. These forces transcend agricultural sectors, spilling over from one commodity to another and also transcend geographical boundaries, given the greater interdependence of the world economy. Continuing macroeconomic turbulence is likely to be a feature of the near term period.

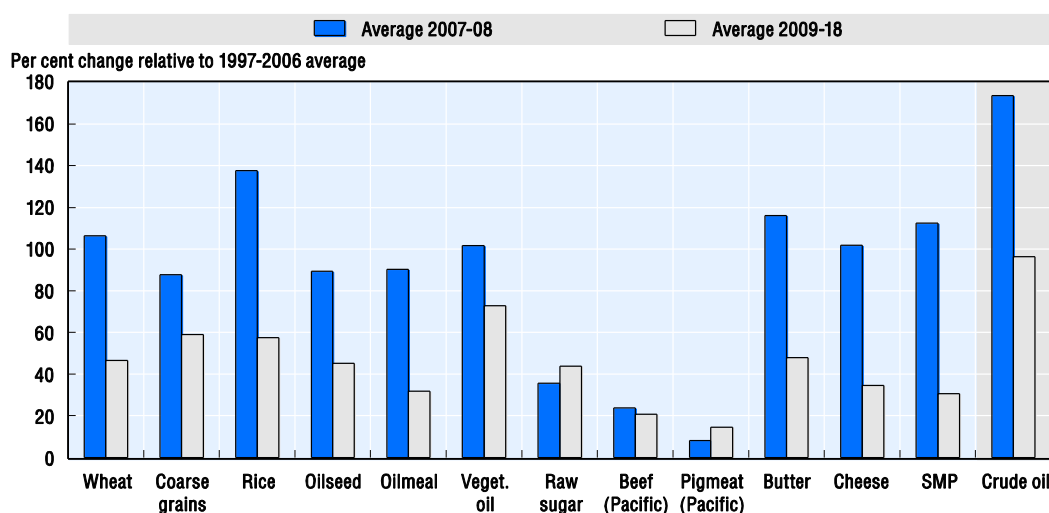
In the immediate aftermath of last year's high-price crisis, there has again been evidence of the rapid responsiveness of global agriculture. High international commodity prices have transmitted signals to farmers to allocate more resources and increase agricultural production. When measured at the global level, the cereal sector for instance, reassuringly responded with a 7% expansion in output. However, not all farmers responded similarly as high world prices are not transmitted to local producers in many instances. A decomposition of the response of farmers by economic regions reveals that: output expansion in developed countries amounted to over 13%, but developing countries together could only muster a 2% increase in their cereal production.

This lack of response from a large part of the world underscores the need for policy reform and additional investment in productive agriculture, particularly in many developing countries. Structural problems are likely to persist, especially for the Least Developed Countries (LDCs), limiting their capacity to produce. The projections for them are marked by growing net imports of basic food commodities. In these countries, population numbers continue to increase rapidly and domestic production growth is unable to keep pace with demand.

Despite low economic prospects and much lower energy prices than seen in earlier market projections, this *Outlook* paints a picture of sustained crop prices in nominal and even in real terms (allowing for inflation) that remain well above the levels observed prior to the 2007-08 price peaks, *i.e.* during the 1997-2006 period. Most livestock prices, in contrast, are expected to remain close to the average levels for that decade in real terms (Figures 1.1 and 1.2).

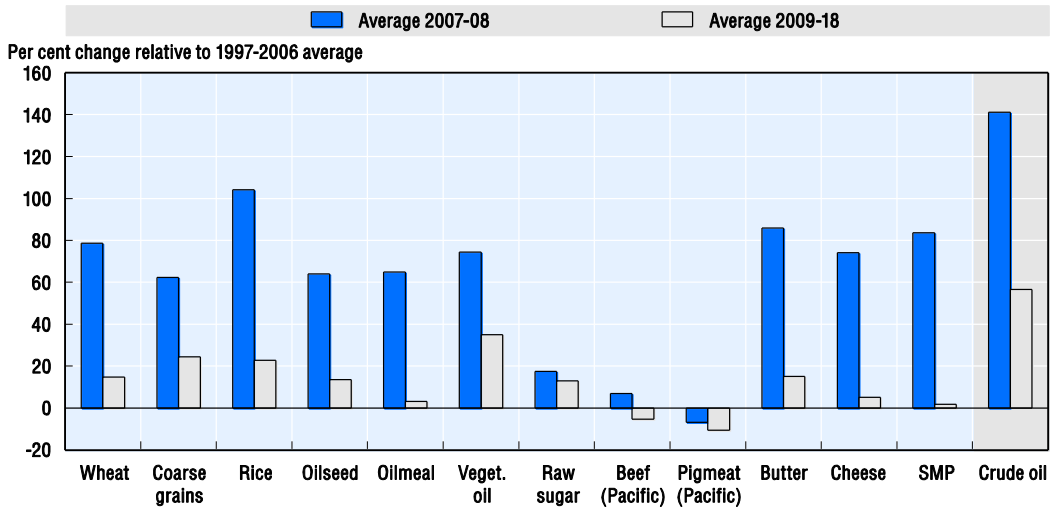
Producers of cheese, skim milk powder, butter, rice and wheat will face average prices substantially lower than the price received in 2007-08. Nonetheless, the *Outlook* foresees nominal prices remaining above the average levels of 1997-2006 over the next 10 years, with vegetable oils having the highest increase. On average, the nominal price of all commodities other than pigmeat, will be 20% or more above their 1997-2006 average level. Similar developments are manifested in the crude oil price assumption with nominal prices substantially below recent peaks, but almost double the average price seen during the 1997-2006 decade. Moreover, the crude oil price scenario discussed in Chapter 2 illustrates that returning to high price levels of around USD 100 per barrel (as assumed in the last year's edition of the *Agricultural Outlook*), would lift crop prices by an additional 20-30%, but with livestock product prices increasing less by around 10%.

Figure 1.1. Nominal commodity prices projected 15-60% higher than 1997-2006 but substantially lower than in the 2007-08 peak



Prices when adjusted for inflation, that is, in real terms, are also expected, on average, to be much below their 2007-08 average peak levels (Figure 1.2). The crops expected to undergo the largest fall in real prices, compared to their 2007-08 average, are: rice, wheat, butter, cheese and skim milk powder. But, over the outlook period, real prices of products other than beef and pigmeat, are expected to be above their average 1997-2006 levels. In real terms, the average crude oil price assumption for the next decade is substantially below its 2007-08 peak, remains well above, by around 60%, the 1997-2006 average level.

Figure 1.2. Real crop prices to fall from peaks but to remain above 1997-2006 average



The increases in most commodity prices in the period 2007-08 and lingering concerns about the potential deleterious effects of climate change on agriculture have highlighted the issue of the potential precariousness of the state of future food availability especially in developing countries. For the medium term, however, the projections imply an increase worldwide of 10% or more for all products included in the outlook suggesting more ample future supplies. As indicated in Figure 1.3 for crops and Figure 1.4 for livestock products, relative to 2006-08 average, worldwide production of vegetable oils in 2018 is expected to be more than 40% greater while that of oilseeds, oilmeals, poultry, butter and whole milk powder is expected to be more than 30% greater. Other than wheat and coarse grains, the *Outlook* foresees agricultural commodity production increasingly shifting away from developed countries towards developing regions, especially among emerging and middle income countries. This shift is especially pronounced for meat and dairy products.

Growth in consumption of agricultural products is also expected to relocate to the developing world driven by stronger population and rising incomes. Relative to average consumption during 2006-08, oilmeals use in developing countries will be almost 60% greater in 2018, while consumption of butter and poultry will be some 50% greater and that of vegetable oils will be about 40% larger.

Figure 1.3. Crops production and consumption growth from 2006-08 average to 2018, per cent

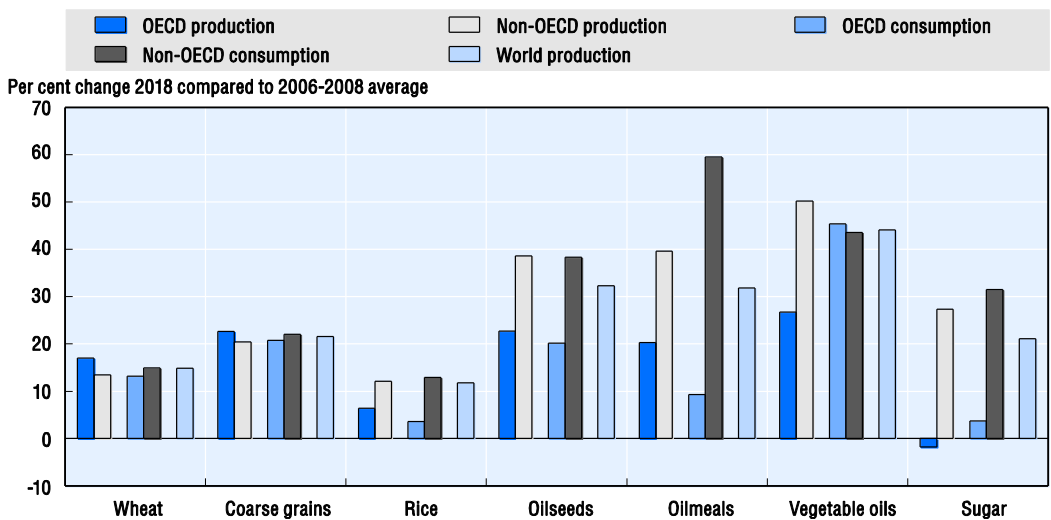
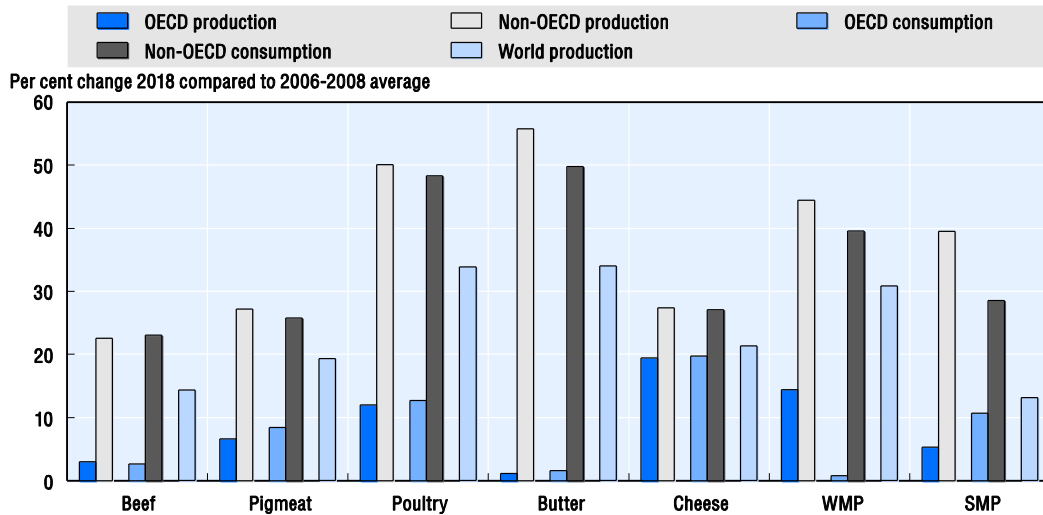
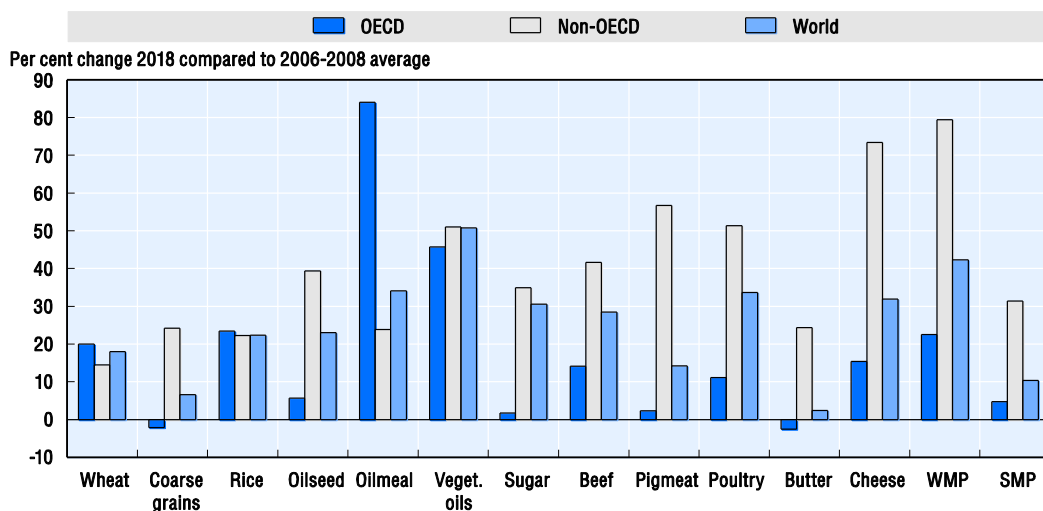


Figure 1.4. Livestock production and consumption growth from 2006-08 average to 2018, per cent



Reflecting the changing global production and consumption landscape, international agricultural markets are progressively becoming characterised by the emergence of non-traditional exporters that are exploiting their emerging comparative advantage in agricultural production. Figure 1.5 reflects the percentage change in exports in 2018 relative to average exports during 2006-08. This shows that trade will continue to deliver products where they have ready markets as exports expand over the next decade. But, butter and coarse grains exports from OECD countries are expected to contract by 2018 compared to their averages during 2006-08. In contrast, a larger share of wheat, rice and especially oilmeal exports will be delivered by OECD countries. Interestingly, over the next ten years, non-OECD countries are expected to provide the fastest growth of value-added agricultural and food products such as beef, pork, poultry, butter, cheese, skim milk powder and whole milk powder, if not always the largest share of trade in all these products.

Figure 1.5. Export growth from 2006-08 average to 2018, per cent



Main trends in commodity markets

Grain markets find a new equilibrium

Prompted by exceptionally high farm gate prices and supported by favourable growing conditions, farmers around the world delivered record wheat and coarse grain crops in 2008, even though the production response was disproportionate between developed and developing countries. Importantly, the growth in output enabled grain inventories to be replenished to levels that calmed and restored confidence in markets. Higher inventories should, other things being equal, provide a buffer for an anticipated contraction in global grain output in 2009 to more normal levels. With the prospect of lower prices over the course of the *Outlook* than anticipated last year, there will be less incentive to expand new, less productive arable area in many countries or in higher expenditures on yield enhancing inputs. Instead, relative price changes will prompt mainly the reallocation of existing land and resources among grain and oilseed crops with those crops offering the highest returns gaining the most ground. Therefore, much of the growth in world grain output is expected to stem from productivity gains, but yield growth is not expected to match the rate attained in the previous decade.

Declining growth in *per capita* demand for staple foods remains an important feature characterising wheat and rice markets. Although the direct food consumption of grains is generally resilient to falling household incomes, demand for grains from other sectors is much more exposed to macroeconomic turbulence. For instance, demand from the biofuel sector for energy feedstocks, particularly for maize in the United States and increasingly for wheat in Europe, is likely to be supported by mandates rather than through competition with petroleum products which, with the help of tax concessions and other forms of public support, was the case in the past few years. Feed grain demand by livestock sectors while continuing to be an important growth driver, particularly in developing countries, will also be moderated by the macroeconomic environment as the consumption for these commodities is much more sensitive to changes in income, though prospects appear brighter ahead.

Wheat transactions fuel expanded grain trade

Growth prospects in global grain trade remain firm but only after several years of hesitant performance. The economic downturn twinned with liquidity constraints looks likely to take their toll on international grain trade and other commodity exchange as well. However, assuming that confidence returns to markets early in the coming decade, world wheat trade is projected to expand at an average annual rate of almost 2% over the remainder of the projection period. The US, the EU and Australia are set to govern global wheat supplies, but by the end of the outlook, the CIS country group is expected to be the dominant source of wheat exports. Developing countries will continue to fuel global wheat demand, such as those situated in South and East Asia, as well as Africa such as Nigeria and Egypt to feed fast growing local populations. Saudi Arabia is also projected to confirm its status as a major importer in view of the recent change in its policy to gradually phase out large production subsidies. Overall rising *per capita* incomes and expanding populations fuelling the food markets of developing countries are behind increased imports and global demand that has outpaced domestic production capacity. But generally, growth in *per capita* food consumption of wheat is expected to remain modest or even to decline in some countries, notably in China. Diets in these countries are slowly shifting towards more value added food products in the face of rising incomes; a phenomenon that has already taken place in much of the OECD area.

In the case of coarse grains, prospects for trade expansion beyond the rate of the preceding decade are much more subdued. The growth in international demand for coarse grains will be predominantly driven by increased feed demand from livestock industries in developing economies which are expected to resume their rapid pace of expansion after several years of lacklustre growth. Imports by these countries as a

group, are expected to grow to 97 million tonnes, representing nearly three-quarters of the world total, offsetting the anticipated decline in deliveries to developed countries.

Productivity increases support the rice sector but climate change could forestall progress

The high price event of 2008 demonstrates just how much political weight rice continues to carry around the world, for the reasons behind the doubling of international quotations over 2006-08 had more to do with government interventions and trade restrictions than with supply and demand fundamentals. The totality of all uncoordinated policy interventions which were made in the hope of shielding domestic markets from external events, only served to heighten international rice prices and volatility.

Soaring rice prices in 2007 and 2008 combined with an intensification of government support, stimulated a strong expansion in paddy cultivation in 2008, demonstrating that the sector can quickly react to improved economic incentives when they arise. The tendency for rice plantings to expand may well continue in the next few years, especially in those countries that have renewed their commitments to rice self-sufficiency goals. However, by the end of the outlook, the area under rice is expected to have changed little from current levels reflecting offsetting country adjustments. Most of the world's largest producers may witness a contraction, with the retrenchment likely to occur in the less efficient subsistence farming sectors, while commercial rice cultivation may be expected to gain ground. Plantings are, however, anticipated to keep rising in Sub-Saharan Africa where large tracks of land suitable to rice cultivation are available. Among OECD countries, rice cultivation is projected to shrink, consistent with either prevailing policies or a down grading of support or due to less favourable growing conditions. But the decline in production is expected to be less pronounced than in the past decade, when most of the sectoral adjustments were made.

As with the other cereal crops, productivity increases are foreseen to remain the principal engine of production growth and lay behind a projected 9% expansion in rice production by 2018. The impact of hybrids and genetically modified strains could be capped by other resource constraints, such as declining soil fertility, and rising competition for land, water and labour. Rice continues to be primarily a basic food staple and this importance is being extended to many parts of the world. However, where rice constitutes the primary staple, especially in Asia, sustained income growth and dietary diversification is expected to depress *per capita* rice consumption, by as much as 2 kg over the outlook. Rising demand elsewhere will drive increased trade flows, especially shipments to Sub-Saharan African countries. OECD countries as a group are projected to import more rice, led by the European Union amid stagnating production with policy reform and rising consumption. Few upheavals are foreseen on the export side of the market, with traditional exporters fulfilling their role over the outlook, but several LDCs in South East Asia could emerge as important suppliers to the global market. Nevertheless, government interventions to regulate the market will again likely be the overriding factor in shaping international rice flows and prices. Lessons learnt from the recent high price episode suggest that world rice carryover stocks could significantly increase over the projection period, but stock levels are not expected to revert to the record highs reached in the late 1990s.

Edible oil demand drives the oilseed complex

Of all the arable crops, markets for oilseed commodities look set to undergo the greatest expansion. By the end of the projection period, global oilseed production is expected to be double the level observed 20 years prior. While still high relative to other crops, the rate of growth over the next 10 years, however, will not match that observed during the previous decade. Much of the foreseen expansion will be concentrated in Brazil, the EU and Argentina, supported by land reallocation from competing crops, diverted pasture lands and some new arable land being brought into production. Such positive prospects are projected to materialise after a difficult few years that have confronted the sector, especially in South

America, where a price-led production expansion was constrained by adverse weather conditions and farm liquidity problems. However, the importance of this region in driving the global oilseed sector should not be underestimated: over the period 2009-18, Brazil's share of global exports is expected to grow from 30-39%, and should emerge as the leading oilseed exporter, eventually surpassing the lead position held by the United States. In addition, the differential export tax system in Argentina should deter oilseed exports and encourage domestic crushing, paving the way for much larger shipments of oilmeals and vegetable oils in coming years.

World oilseeds crush will continue to be dictated by vegetable oil demand. The pace of growth in this sector will likely exceed the rate of expansion in oilseed production. Indeed, largely driven by sustained income growth once the current economic crisis is overcome, vegetable oils, both from oilseed crops and from palm, will remain the fastest growing commodity in terms of consumption covered in this outlook. Much of the projected demand growth will arise from the food sector, where developing countries situated in Asia could account for almost two-thirds of the global rise in use, but increasing biofuel mandates still play an important role. The relative importance of vegetable oil as an energy feedstock will be increasingly contingent on politically set biofuel mandates and other support policies as the profitability of biodiesel production *vis-a-vis* fossil diesel prices remains a particular challenge. Current projections indicate that the derived demand for vegetable oil in biodiesel production could represent 20% of global vegetable oil consumption by the close of the outlook period.

The rising intensification of livestock sectors which is projected in developing countries is expected to be a key demand driver for the protein meal market, in contrast to rather stagnant demand for this commodity among OECD countries. At the end of the projection, China is expected to surpass the European Union as the leading oilmeal consumer. Substantial growth is also anticipated in Brazil, the CIS group and in India. Domestic demand in the latter country for protein meals has been declining for several years to the benefit of exports, but a reversal could take place on account of projected low prices of oilmeal relative to feedgrains. In the United States, oilmeal usage has likely been constrained by the increasing availability of low cost dried distiller's grains, a by-product of ethanol production, which is expected to displace almost 8% of future meal consumption by 2018. In spite of rapidly rising oilmeal consumption in non-OECD countries, when consumption is expressed as a ratio of non-ruminant meat production, average consumption levels in these countries remain far below levels in the OECD area. The contrast is even more striking among least developed countries, where for a 1% share of global non-ruminant meat production, their share of global protein meal usage amounts to just 0.5%.

Policy reform and energy demand set to shape sugar markets

An exception to last year's soaring price episode for most commodities was international sugar markets where prices remained relatively low. If recent history can be taken as a guide, many non-sugar factors, including the outlook for crude oil and other commodities, exchange rates and freight rate developments affecting export competitiveness of sugar industries, and the performance of sugar futures markets with further financial market integration can be expected to continue to affect sugar prices and their volatility. As a consequence, the sugar market has entered a period of greater instability and uncertainty given a growing number of price determinants in addition to traditional market fundamentals. The outlook is further obscured by ongoing policy reform in sugar sectors in major producing and trading regions such as in the EU as well as in North America.

After losing ground in the base year to other crops with expected higher returns, global sugarcane production is projected to register a marked acreage expansion, which by 2018 would give rise to a combined output increase of 2%. How much of this translates into additional sugar production will rest on the allocation of sugarcane to ethanol production in Brazil, the world's leading sugar producer and exporter, and a major ethanol producer based on sugarcane juice as the feedstock. The upswing in sugar

beet cultivation, on the other hand, is expected to be far less dramatic owing to a sharp contraction in the EU harvested area, following policy reforms. The adoption of improved sugar varieties is expected to some degree to sustain crop productivity over the outlook period; albeit at a slower rate when compared to the last decade.

Relative to other commodities, the demand for sugar is relatively passive to changes in world prices but much more responsive to income changes. This is evident from periods in the past when world consumption slowed down sharply during times of recession. The unprecedented global financial crisis and deepening economic downturn in the world economy in 2009 can be expected to have some immediate impact on per capita consumption, but over the medium-term, high demand growth of the developing countries should remain steadfast in the wake of fast population growth, and with diets increasingly geared towards processed and convenience foodstuffs utilising sugar. The opposite development is projected in OECD countries, where consumption could stagnate on account of declining population growth and dietary shifts away from sugar amid increasing health awareness and concerns with obesity. Non-OECD countries should account for virtually all the increase in world sugar production and consumption over the outlook. By 2018, their share in both market aggregates could rise to the proximity of 80% of the world total.

The EU could emerge as the leading global sugar importer, on account of sectoral reform that has led to a huge structural contraction in sugar production and sugar beet cultivation. The majority of sugar inflows to the EU will be sourced under preferential import arrangements with the African, Caribbean and Pacific (ACP) countries in the context of new Economic Partnership Agreements (EPAs) and with LDCs under the Everything-But-Arms initiative, but uncertainty prevails regarding export capacity and incentives in many of these countries. Under provisions in the North American Free Trade Agreement (NAFTA), the United States' sweetener market became fully integrated with Mexico in 2008; in the same year, the US's new multi-year farm legislation (the FCE Act) also came into effect. This will result in higher US market prices that are expected to encourage increased sugar imports from the NAFTA member Mexico. The *Outlook* foresees that the United States will re-surface as a major net importer of sugar (as is the case of the EU), with some additional inflows originating outside NAFTA countries, especially from those that have negotiated to fill the country's WTO tariff free quota and from third countries with Free Trade Agreements.

With low production costs and the potential to bring substantial additional land into production, Brazilian sugar production is expected to grow some 36% over the outlook, and could propel exports to new heights. Overall outcomes hinge on the price relative between ethanol and sugar, which is foreseen to regulate a 60% share of cane being diverted to ethanol production by 2018.

Poultry and pigmeat demand in non-OECD countries underpins the global meat sector

Meat prices also proved an exception to the high price event of last year. Falling profit margins as a result of inflated feed costs, in some instances, prompted livestock farmers to liquidate herds, increasing meat supplies and lowering prices. These additional supplies tended to dampen any upward pressure on prices. In other instances, farmers downsized operations by not restocking herds after slaughter. But perhaps the most important factor that capped price increases was the onset of a contraction in demand induced by falling purchasing power around the world with the economic downturn. Of the meat sectors hardest hit, beef meat and pigmeat stand out. Confronted with declining budgets, consumers are expected to switch from higher priced animal proteins to less expensive meat products.

After the turning point is reached in the economic downturn, the remainder of the meat outlook is characterised by moderate increases in production and consumption in developing countries and a more stable path of development in the mature OECD markets. Overall global production growth - a little under 2% per year - is expected to be registered and this will be at a slower pace than witnessed in the past

10 years. The expansion of meat production in non-OECD countries could outpace growth in OECD countries by a factor of 2:1, such that 87% of the expected growth in global production can be attributed to non-OECD countries. Renewed investment, capacity building, improved infrastructures and the introduction of modernised, intensive and integrated production technologies, are the main factors spurring higher growth in these countries. This is especially true for poultry in the emerging economies of China, Brazil and India, and to some extent in the CIS group of countries which could lower their import dependency on meat products. As a result, some of the emerging countries, notably Brazil, will be able to increase substantially their presence in supplying international meat markets. Given abundant land resources, capital and technology in combination with policy reforms and disease controls, Brazil is expected to assume one-third of total world meat exports by the end of the outlook; fuelling a 25% rise in meat shipments compared to the 2006-08 period. A handful of major exporters including the United States, Canada, Argentina and Australia, alongside Brazil, will remain the dominant traders in world markets. In contrast, the export share of the EU is expected to further deteriorate over the outlook, owing to policy reform and rising domestic consumption.

The resumption of a trend of increasing purchasing power in developing countries, will lead to dietary changes that are increasingly orientated towards protein foodstuffs and additional protein of animal origin and away from staple foods of vegetal origin. Overall meat consumption in developing countries is expected to account for around 82% of projected global growth. Much of this expansion will take place in Asia and the Pacific region, especially in China and also in Latin America, led by Brazil. Such growth will reflect in particular the rise in consumption of cheaper sources of animal protein, mainly poultry and pigmeat. Import dependency in meat products is likewise expected to grow in many dynamic developing countries as demand surpasses the domestic capacity for meat production throughout the duration of the outlook, although the credit crisis can be expected to slow meat trade to certain destinations in the short-term. Among the developed countries, the United States is set to assume the mantle of world's largest meat importer by 2018, followed closely by Japan and then the EU.

Another development in the outlook for meat demand concerns the further entrenchment of established consumer preferences. In countries where pork consumption is traditionally high, such as in Asia, pigmeat consumption will continue to grow at a faster rate than any other type of meat. Similarly, in countries where beef meat production is important and international prices have little impact on domestic production, such as in East Africa, beef meat will remain the preferred type of meat consumed.

Developing countries fuel dairy output growth but only few participate in export expansion

The spectacular increase in international dairy prices was followed by a rapid decline with prices falling by half to two-thirds from the record levels of mid-2007. Prices were driven down by increased production, responding to earlier price rises, and by retreating demand. The economic contraction is expected to weaken demand and put pressure on dairy prices in the short term, but prices are projected to strengthen when economic prosperity returns to global consumers. Dairy demand over the medium term is expected to expand particularly in developing countries where increased consumption is not only governed by income and population growth, but also driven by factors such as changing preferences, changing diets and dietary diversification, all of which will be encouraged by further urbanisation with economic growth and development. These drivers are likely to be reinforced by growth in dairy marketing, increased product availability and retailing channels. Over the outlook, dairy products are expected to remain among the agricultural commodities for which consumption exhibits the highest growth rates.

In tandem to these broader changes, the outlook foresees dairy sector as more competitive and more responsive to market signals. Rising supply potential in developing countries stimulated by investment and restructuring, will enable future production growth and improved domestic marketing linkages, placing these countries in a stronger competitive position in regional and global markets. As a result, milk

production gains over the outlook period will be overwhelmingly driven by output growth in non-OECD countries, which could capture as much as 81% of the anticipated total increase. Much of the expansion is set to originate in Asia, including India, the largest producing country in the world, and also China and Pakistan. Milk production growth will allow such gains to be transformed to higher butter output in South Asia (India and Pakistan) and greater WMP production in South East Asia (China) - the two products and the two sub regions set to drive the global dairy expansion. Brazil is also foreseen to fuel world dairy output through higher WMP production. It remains, however, uncertain how much the milk production expansion and needed investment activities in developing countries will be impinged by the unfolding economic crises and financial credit constraints.

Among the OECD countries, New Zealand is to remain a country recording the strongest milk production growth in percentage terms. In Australia, dairy cow inventories are expected to increase in 2009 for the first time in seven years with a return to normal seasonal conditions paving the way for the country's more positive dairy outlook, but for such prospects to translate to material gains, much would rest on future water availability. Policy interventions are expected to contribute to shaping the dairy production outlook landscape. For instance, the EU has decided to abolish the long standing milk production quota system in 2015 allowing efficient milk producers to expand. The United States has confirmed support to its milk producers through provisions in the 2008 US Farm Act (FCE Act). Milk production growth in the United States could account for more than 40% of additional milk production in the OECD area.

In spite of an expected expansion in trade, international dairy markets will continue to be classified as "thin" and hence susceptible to price swings. World exports of dairy products are expected to grow for all products with only a few developing countries able to erode the shares of the traditional OECD exporters of New Zealand, Australia, the EU and the United States. However, given that the composition of international dairy product trade is expected to increasingly favour WMP and value added products, an opportunity is presented for the Mercosur countries of Argentina, Brazil and Uruguay to challenge the dominance of the traditional exporters.

Import markets will remain rather fragmented compared to those for exports. The six largest importers of dairy products are expected to account for less than half of the world market. Developing countries are expected to absorb 96% of global WMP deliveries, 92% of SMP shipments, 57% of traded butter and 44% of cheese exports. Significantly narrowing the dairy trade deficit with OECD countries presents a challenge for developing countries for the years to come. An important future endeavour, especially for developing countries, will be the ability to maintain an image of dairy products as being healthy and safe. The need to ensure the safety and quality of dairy products is expected to result in increasingly strict requirements for producers in the future and more stringent testing of milk at various stages of distribution and processing.

Biofuel demand likely to be driven more by policy mandates than by markets

Prospects for biofuels are increasingly driven by quantitative mandates, either in the form of blending requirements or set as minimum biofuel quantities to be used in the national transport sectors. Under these circumstances, general uncertainties about other factors, including feedstock prices, crude oil prices and changes in policy measures other than mandates, become less crucial, although this might change should there arise significantly higher crude oil prices than those assumed in this outlook. However, two important areas of uncertainty remain: the pace of commercialisation of second-generation biofuels; and the options for waiving biofuel mandates if certain conditions related to food security, biofuel economics and environmental issues are met.

With the exception of Brazilian ethanol production, the commercial viability of biofuel supply has been, and still remains, a challenge for many sectors throughout the world. Recent developments have

shown that in spite of weakening feedstock prices which translate into falling production costs, even lower crude oil prices have left biofuels struggling to compete with fossil fuels. It is not surprising, therefore, that public support measures will be the most important drivers of ethanol and biodiesel markets throughout the projection period.

With both total transportation fuel use and the share of diesel fuels rising across the world¹, and stimulated by rising mandated demand for blending with transportation fuel, global biofuel production is foreseen to undergo a rapid expansion, going beyond doubling of base year levels, to reach 192 billion litres by 2018 - 148 billion litres of ethanol and 44 billion litres of biodiesel. Such a prospect arises in spite of the recent slump in crude oil prices and projection of only a moderate increase in the future.

The world reference ethanol price, which averaged USD 48/hl in 2008 is expected to fall by a fifth in the current year, and then to trend gradually upwards to 2018. The strengthening of prices over the outlook is the net result of an expansion in policy-induced use around the world and the dampening effect of rising growth potential in Brazilian ethanol production and exports. Similarly, owing to the influence of mandates, particularly in the United States and the European Union, biodiesel reference prices could remain well above production costs of fossil diesel. International biodiesel prices are expected to fall in 2009 and then to steadily rise towards 2018.

United States, Brazil and the EU continue to dominate biofuels

Policy implementation in the United States - with the passage of the Energy Independence and Security Act (EISA) and particularly the Renewable Fuels Standard - could pave the way for domestic ethanol distilleries to produce 63 billion litres by 2018, 83% above the 2008 volume, but resulting in total biofuel use to remain some 24 billion litres below the level mandated for that year. Cellulosic ethanol could make some progress, but with only 5.4 billion litres expected to be produced will fall short of the 26.5 billion litre requirement set for 2018. In the EU, following the introduction of the new Renewable Energy Directive which calls for a 10% share of renewable energy in the transport fuel mix by 2020, ethanol production is set to rise markedly over the projection period, reaching an average share of 6.6% in gasoline fuel usage by 2018. Imported ethanol will play an increasingly important role in fulfilling the mandate, and inflows could rise to 3 billion litres by the end of the outlook. Ethanol in Brazil will remain a rapidly expanding and increasingly export-oriented sector, and production should grow by around 9% annually on average over the next ten years. With sugar cane juice remaining the cheapest of the main feedstocks for ethanol, Brazil will continue to be very competitive in supplying an ever expanding international market, where global trade could reach 13 billion litres by 2018.

The EU is particularly focused on biodiesel, and while this focus is expected to decline somewhat in favour of ethanol, biodiesel could attain an energy share of 7.4% in fossil diesel usage by 2018. As a result, the EU is projected to remain by far the largest biodiesel market, accounting for more than half of all global biodiesel output throughout the outlook. Steadfast biodiesel demand will be met by both increased domestic production and, particularly towards the end of the projection period, growing biodiesel imports. Given high biodiesel prices, growth in biodiesel usage in the United States will almost entirely be driven by mandates which require 3.8 billion litres of biodiesel to be used in 2012. By contrast, biodiesel use in Brazil is assumed to grow rapidly following ambitious government targets, and could represent 4% of fuel usage by 2018, compared to just under 2% in 2006-08.

¹ Assumptions for transport fuel consumption are based on data obtained from IEA, national and other sources. Assumed growth in major biofuel producing and using countries is generally close to or below historical trends.

The stage was set last year for many developing countries, especially in Sub-Saharan Africa and in South East Asia, to embark on ambitious renewable energy programmes. The recent high oil price event spurred a myriad of project proposals, but most of them were put on hold at the onset of the economic crisis as oil prices fell and future market prospects became uncertain, especially in the context of concerns over longer term food security. A prime example of these constraints is given by *jatropha curcas* in Sub-Saharan Africa where the potential has been extensively debated in recent years, but actual production has been miniscule so far. Given the current investment climate, the *OECD-FAO Agricultural Outlook* presents a conservative view on biofuel prospects in many of the developing countries over the projection period.

Agricultural commodity markets have responded strongly to high prices

A major feature of the previous year's outlook concerned the potential for high and protracted prices of almost all agricultural products in real terms. While the relative importance of the many transitory and permanent factors that lay behind today's price trends could change tomorrow, there is lessening evidence to suspect that the world has undergone any structural upward shift in real agricultural commodity prices. For such a tendency to occur, the underlying forces that provide momentum to agricultural product supply will need to be continually outweighed by the forces that drive stronger demand for these products. But the high price event of last year showed that price signals did provoke a significant supply response. Assisted by a downturn in the global economy, this response was sufficient to calm markets and to restore some confidence in the international arena, though at the expense of aggressive stock building and policy measures to enhance self sufficiency.

However, further episodes of strong price fluctuations cannot be ruled out nor can future short-lived crises. This is particularly evident when considering the heightened linkages between crop and energy prices. Energy markets have long influenced the supply side of crop production, *inter alia*, through their direct effect on fertiliser, production and transportation costs. However, with the emergence of the biofuel sectors, particularly in the important crop production and exporting markets of OECD countries, have now forged a more dynamic link to crude oil markets particularly for grains, oilseeds and sugar, but also indirectly to other land competing crops. It is increasingly apparent that variability in crude oil prices now substantially impacts crop prices, even though this link is weakened by the increasing importance of quantitative biofuel mandates as illustrated in Chapter 2. In addition, given much more macroeconomic interdependence and globalisation in the world today, the fragility of economies could be exposed from the transmission of global financial and economic shocks onto domestic markets, profoundly affecting the competitive positions of nations wishing to trade on international markets, or to build domestic capacity. Finally, more frequent weather disturbances associated with climate change may render yields much more variable, leading to instability in trade flows and hence international prices being prone to greater swings.

Productivity increases and higher stocks to contain prices but energy linkages to add pressure

World cereal inventories, having reached very low levels in recent years, are expected to increase over the projection period, bolstering stock-to-use ratios to the tune of 30% for grains and 22% for rice, which should help to buffer or restrain upward price movements. As a consequence, wheat prices in real terms are projected to resume their long-term decline, albeit from a higher level and at a somewhat slower rate. Coarse grain prices in real terms should also resume their downward trend, but only from around 2015 when the United States' mandate for maize-based ethanol reaches its maximum level. Concerning rice quotations, the trend in falling real prices could stabilise, making rice slightly more expensive relative to wheat. Nevertheless, in nominal terms most crop markets are expected to see increasing prices over the outlook (Figure 1.6).

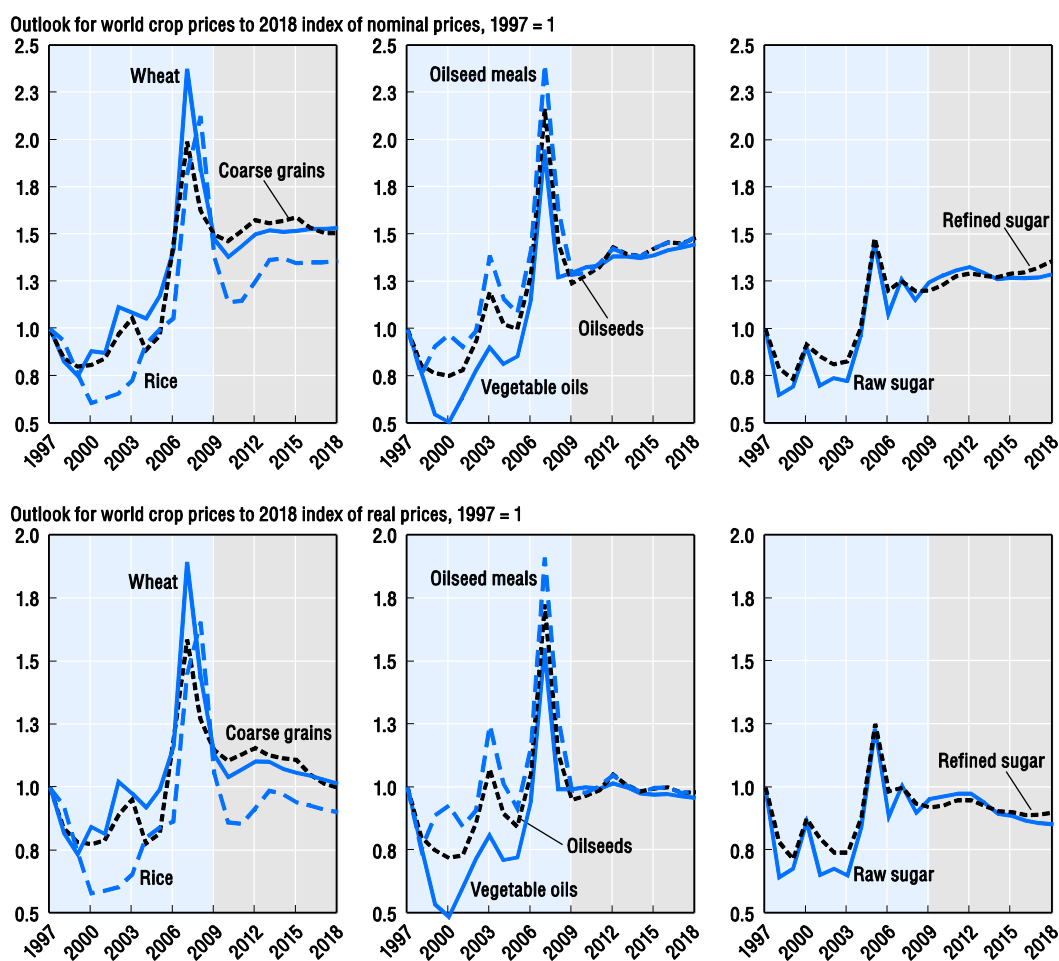
Rising demand for vegetable oils, both for food and to fuel the growing biodiesel sector is expected to weigh heavily over the medium-term, leaving stock to use ratios in the oilseed complex under some

pressure. However, prices of oilseeds, oilseed meal and vegetable oil, once corrected for inflation, are expected to remain stable over the outlook period, but would stay above long-term trend levels, especially for vegetable oils and oilseeds and markedly increase in nominal terms (Figure 1.6).

Some strengthening in sugar prices and the white differential towards the end of the Outlook

Lower expected growth in sugar consumption and imports in the developing countries undergoing economic contraction, could spell weaker sugar prices over the medium-term. However, thereafter a recovery in demand growth accompanied by stock rundowns could see quotations firming by the end of the projection period. The white sugar premium is projected to narrow in the near term when new refining capacity comes on stream, but then to widen by 2018 when increasing supplies of raw sugar arrive on the market together with rising sugar refining costs keeping white supplies relatively tight (Figure 1.6).

Figure 1.6. Outlook for world crop prices to 2018



Source: OECD and FAO Secretariats.

Meat quotations likely to fall in real terms but dairy product prices to hold firm

Notwithstanding the effects of falling incomes in the short-term, relatively stable feed costs and domestic meat capacity growth in major exporting countries as well as traditional importing countries is

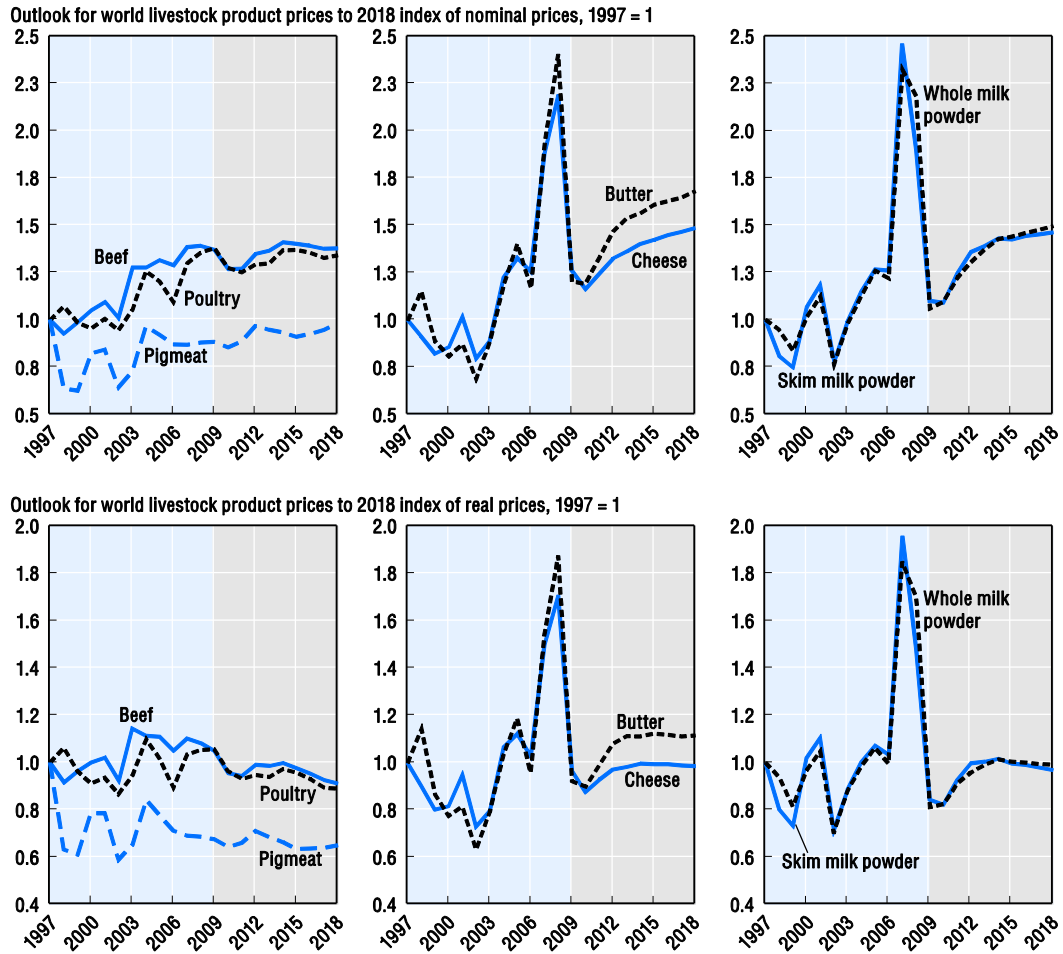
likely to bear down on real international meat prices, while in nominal terms prices are expected to increase initially - staying relatively flat in the second half of the projection period (Figure 1.7).

Spurred by rising global incomes, world dairy product prices are expected to rebound from 2011 onwards, even in real terms. While this upward trend could dissipate in the second half of the projection period, average prices in real terms over the outlook period are expected to stay slightly above the 1997-2006 average, with butter quotations especially supported by rising energy and vegetable oil prices (Figure 1.7).

However, it is likely that continued weakness in the general economy will somewhat dampen commodity prices, at least, over the next 2-3 years. As demand for food is relatively income inelastic, less adjustment in consumption patterns to recession can be expected especially in the higher income OECD countries. Chapter 2 looks at this issue in more detail. The income scenarios discussed in Chapter 2, based on assumptions of a deeper recession, suggest only moderately lower commodity prices and production and consumption adjustments, when compared to outcomes from the outlook baseline, with livestock producers facing a larger demand response to income changes than crop producers.

For the crop and biofuels products maize is the most responsive crop to the income fall, reflecting the higher income elasticity from its primary use as a feed ingredient in livestock rations (see Chapter 2 for full description). Nevertheless, it should be noted that the Chapter 2 scenario analysis does not take into account reduced import demand due to cancelled import orders resulting from financial crises and credit constraints. The impact of credit restrictions goes beyond the Aglink-Cosimo model capability but it is discussed qualitatively in Chapter 2.

Figure 1.7. Outlook for world livestock product prices to 2018



Source: OECD and FAO Secretariats.

Main trends in food prices

Food prices remain high but are falling

Rising commodity prices in 2007-08 contributed to sharp increases in food prices, particularly in developing countries where food is purchased in a less processed form. While commodity prices have recently declined, this change has not yet worked its way through to food prices in all countries. Over the past year, ending in February 2009, food price inflation continued to outpace overall inflation; however it has come down from last year's high rates.

While the outlook does not project food prices, there is a great deal of interest in how fluctuations in commodity markets translate into changes in the cost of food. For this reason, it is instructive to examine how food prices around the world have changed in recent months as commodity prices have declined. The

food price evolution described here is based on the food price component of the Consumer Price Index, CPI, and is simply the price changes of a fixed basket of foods measured at the retail level.²

The specific foods composing the basket are selected to reflect consumption patterns in different urban areas.³ Thus, the measure provides a good indication of overall change in the cost of food that consumers actually face when making purchases. Food is a particularly important component of the CPI in low income countries because food purchases account for a large share of total consumer spending. Detailed information on the CPI and food price data as well as the latter's contribution to inflation is provided in the Annex Tables to this report.

How important is the food component in the CPI?

Food price increases are an important component of overall inflation, which is frequently a major guide in the setting of wage-demands and other income assistance benefits. Inflationary pressures, particularly those associated with food price increases, have also generated vociferous social tensions at times and, thus, such indicators are closely watched by governments.

The weight of the food component in the CPI varies significantly across countries reflecting the structure of household expenditures. In high income countries, the share of food in the CPI ranges from 10-20% but in the low and middle income countries it is substantially higher, generally in the 40-60% range. For example, the food component accounted for 47% of the CPI in Sri Lanka, 58% in Malawi, 47% in India and 49% in Peru in 2008, but was only about 10% of the CPI in Germany, United Kingdom and the United States and about 20% in Japan, Mexico, and Spain. While information on consumer expenditures according to socio-economic groupings would provide greater understanding of the impacts of food price increases in a given country, very few countries undertake their surveys in this fashion.

Rising food prices has meant larger shares of income being devoted to food expenditures, thus leaving less money available for non-food items, such as housing, transportation, health and educational services particularly in developing countries. Because of its importance and high visibility, food price inflation continues to be a closely watched economic indicator. Governments have often responded to rising food prices with a wide range of policies designed either to support incomes and/or to reduce food costs and this in both OECD and non-OECD countries.

How fast have consumer food prices been rising?

Food price inflation measured over the past 12 months, ending February 2009, has declined from that of a year ago in many countries. But for a number of countries it has continued to increase for instance in Japan, Mexico, Korea, and the United Kingdom as well as for non-OECD countries such as Ghana, Kenya, India, Pakistan, and South Africa. Food prices continued to increase in most countries through the summer of 2008 along with commodity prices - agriculture and oil - as these worked their way through to food prices with at different speeds. The speed and degree of transmission of commodity prices from

² Data for OECD countries is taken from the *OECD Main Economic Indicators*, April, 2009 and for non-OECD countries from the national statistical services.

³ The share of agricultural inputs to the cost of the food basket varies across countries, for instance in the United States the account for only 20-25% of the total, with the remainder attributed to labour, energy and distribution costs. In low income countries the value of the share of agricultural inputs in final food prices is much higher as other costs are generally lower and diets contain a larger share of foods which are highly processed or subject to high distribution costs. Changes in agricultural food commodity prices and in food prices are generally highly correlated but the pass through effects depend on structure of consumption as well as a number of policy variables which may affect international price transmission, where agricultural food commodities are a significant part of the consumer's food basket. To better understand the linkages between these international prices and domestic food prices rigorous analysis of food systems and statistical properties are needed

international to domestic markets as well as their contribution to the composition of the food prices, determines their impact on the food price index.⁴ Where transmission is rapid, complete and where agricultural commodity content of food is large, food prices should adjust rapidly to changing commodity prices. But if transmission is slow, then effects of previous commodity price increases also appear with a lag. This may account for overall price increases occurring after commodity prices have come down.

A closer look at food price inflation over the recent 6 and 3-month intervals indicates that there has been a marked slowing in food price increases in recent months and with many countries experiencing negative rates of change. (Figures 1.8 and 1.9). For instance, the percentage change in the food price index was negative in countries, such as Estonia, China, Chile, Bangladesh, Senegal, Pakistan, the US, Japan and Spain. In China, for example, there has been a spectacular reversal in food price inflation: from over 20% in 2007 to -1.9% in 2008 with a further acceleration in the decline over the past 6 months, at -4.75%, but this decrease has now slowed. In the other countries, that is, Brazil, Russia and Indonesia, there has also been a slowing of food price increases but they have not been as significant as in the case of China. Annualizing the recent 3-month rate of increase would imply a halving of food price inflation from last year in Brazil and about 25% reduction for Russia and Indonesia.⁵ But there is substantial variation among countries and generalizations are not possible.

What has been the effect of food prices on overall inflation?

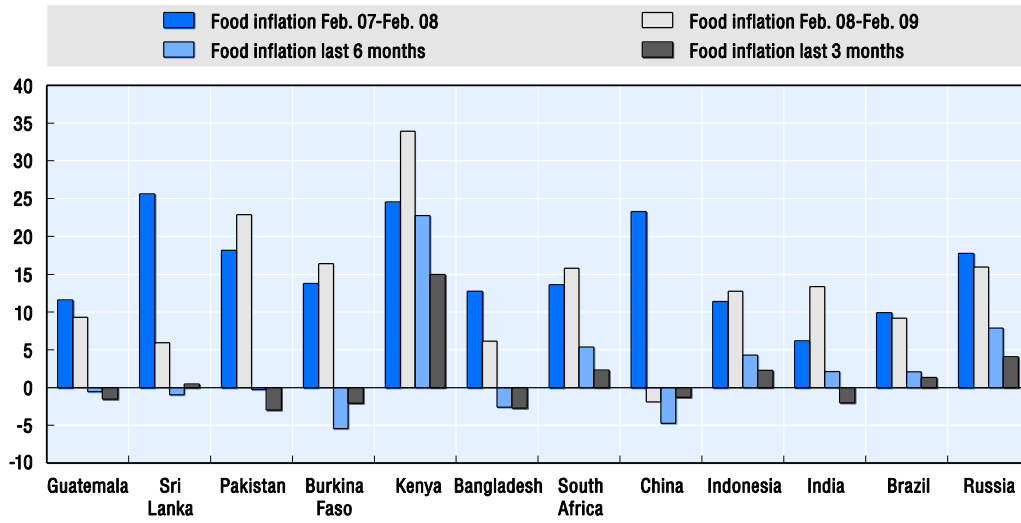
In high income countries, the contribution of food price increases to overall inflation has been quite limited over the past year ending February 2009, generally below 1% (Figures 1.10 and 1.11). This is not only because food prices increases were relatively moderate but because the share of food in the total consumer basket is small. In the US, Italy and Japan food price increases contribute about half a percentage point to inflation and less than .3 percentage points in countries such as Switzerland, France and Germany. As would be expected, the impact of food price inflation on overall inflation in low income countries is much larger. For example, food price increases contributed over 8 percentage points to an overall inflation rate of 21% in Pakistan and 2.5 percentage points to an overall rate of 5.9% in Brazil. These are significant contributions even if absolute numbers may not be very large.

This brief snapshot of food price changes in selected countries indicates a slowing of food price inflation and in many cases there is deflation in food prices. This should not be misconstrued to imply that food prices have fallen significantly yet in absolute terms, since the food price indices indicate that prices remain high relative to pre 2007 levels, at least for the set of countries examined here.

⁴ Both food commodities and oil are important in components in food costs. In OECD countries oil accounts for about 20% of final food prices, about the same as commodities on average.

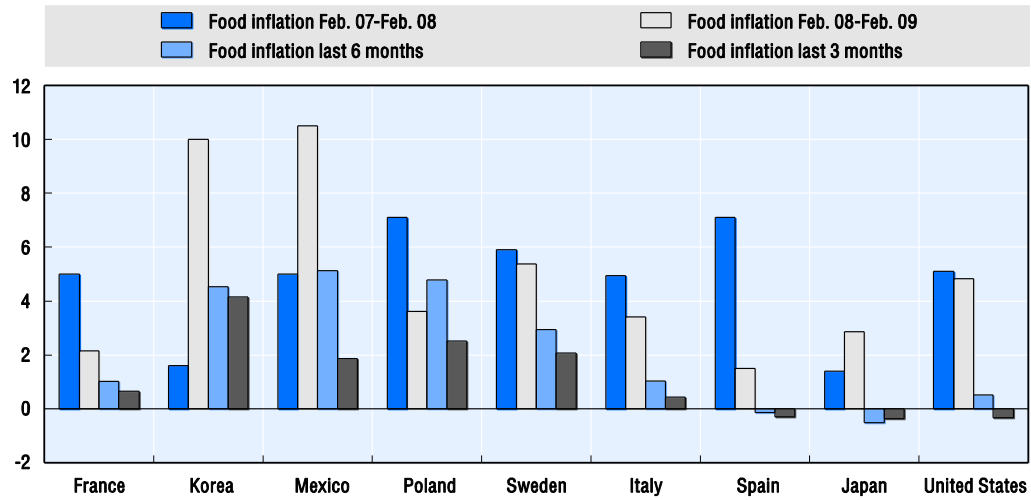
⁵ For comparison purposes it would be necessary to annualise the 3-month change in prices. If deseasonalised, these rates can be simply multiplied by 4.

Figure 1.8. Food price inflation for selected non-OECD countries



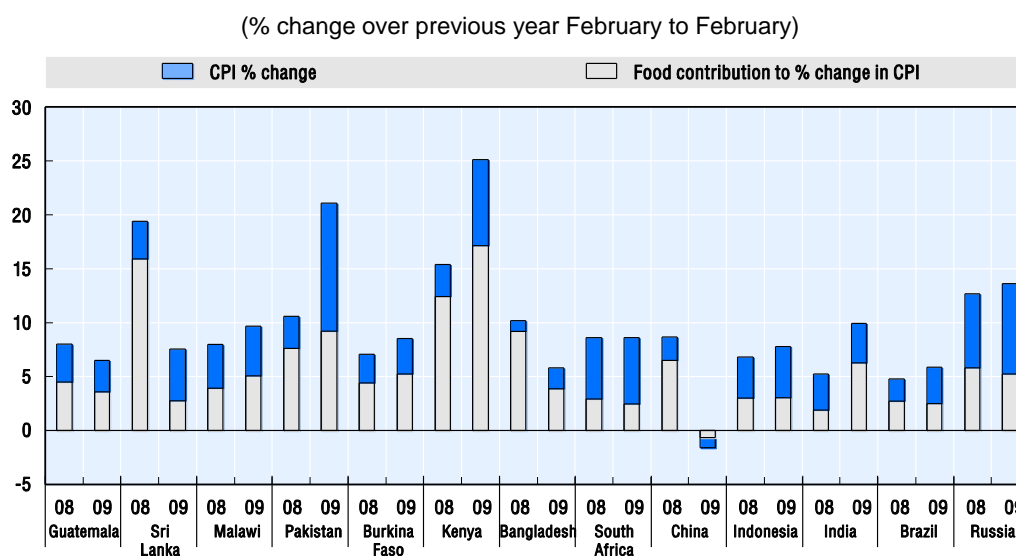
Source: OECD Secretariat.

Figure 1.9. Food price inflation for selected OECD countries



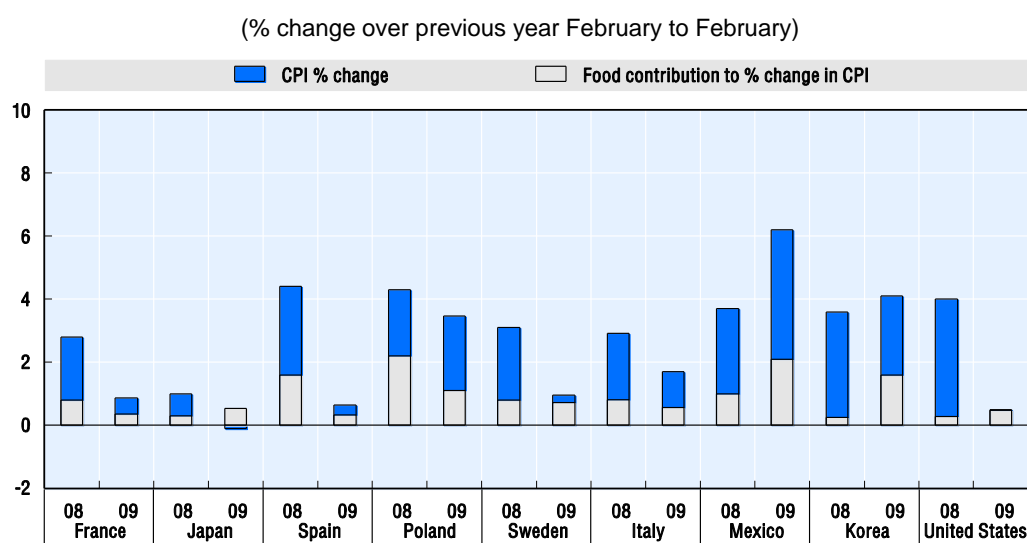
Source: Main Economic Indicators.

Figure 1.10. Contribution of food to inflation for selected non-OECD countries



Source: OECD Secretariat.

Figure 1.11. Contribution of food to inflation for selected OECD countries



Source: OECD Secretariat.

The Outlook and food security

This outlook paints a fairly positive picture for agricultural markets: an agri-food sector relatively resilient to the current economic crisis, real commodity prices to remain above historical averages; production, consumption and trade to increase in developing countries. But behind this scenario lies a more disturbing story where world food insecurity has increased in the past couple of years, with extreme poverty and rising hunger. High food costs, combined with the global credit crunch, falling international

trade and investment flows, lower remittances and budgetary pressures on development aid, are reversing the progress made in combating global poverty, with an estimated one billion people now below the hunger threshold. Chapter 3 examines the longer term supply side of the food security issue.

CHAPTER 2

HOW RESILIENT IS AGRICULTURE TO THE GLOBAL ECONOMIC CRISIS?

The deepening of the financial and economic crisis

Business is not as usual

This year's *Agricultural Outlook* was produced under particularly unusual circumstances. What makes this year exceptional is the fact that the global macroeconomic environment – which forms the bedrock of our agricultural market projections – continues to deteriorate.

Since the beginning of 2009 there has been a constant flow of increasingly pessimistic macroeconomic news from virtually all sources. The OECD in its *Interim Economic Report* for March 2009 concluded that the world economy is in the midst of its deepest and most synchronised recession since the post war period (OECD, 2009a). The result is lower output, reduced trade and capital flows and higher unemployment world wide as well as a steep decline in consumer and business confidence. This global downturn in economic activity is accompanied by a precipitous decline in international trade. The collapse in international trade may explain why the crisis has spread so rapidly to so many economies. Both the credit crisis and the drop in demand, amplified by the prevalence of global supply chains, are seen as major causes of the collapse in international trade flows.

Moreover, it is not yet clear that the economic crisis and its consequences have bottomed out. Bank lending remains tight, however there are signs that equity markets are beginning to pick up. Overall, the prognosis about the depth and duration of the global contraction is highly uncertain and makes difficult any projections of key macroeconomic indicators such as income growth, employment and trade over the medium-term. Both the OECD and the World Bank have revised down their short-term expectations for growth for 2009 and 2010, though both expect a rebound in 2010. However economic growth will likely remain below potential and its recovery path uncertain.

What does it all mean for the Agricultural Outlook?

Because food is a basic necessity, the agri-food sector is expected to be more resilient than other sectors to the present crisis. But this does not mean that it is immune to the economic contraction and financial market turmoil. And the risks faced by agriculture are likely to be accentuated with any deepening and prolongation of the period of economic downturn.

The decline in real income should dampen demand for agricultural commodities, and, all else equal, decrease agricultural product prices. These impacts are likely to be less in high income countries where the elasticity of demand with respect to changes in incomes are low for most agricultural products and where food markets are close to saturation, than in low-income developing countries. The impacts can also differ greatly among the various agricultural sub-sectors and commodities. For instance changes in the composition of demand can be expected as some products such as meat and dairy which have higher elasticity or response of demand to income changes.

Falling agricultural commodity prices in the economic downturn may help compensate consumers for some of the income loss, while on the supply side, lower oil prices may help farmers, through reduced costs of oil related inputs, to offset the cost-price squeeze. At the same time, both oil prices and income changes can have implications for biofuel use and hence for the derived demand for feedstock commodities. The net effect on the agricultural sector is thus complex and will depend on the product and country being examined. The various outcomes for the main commodity markets of lower GDP and income growth are discussed below.

Impact assessment of alternative scenarios

The baseline projections in this report reflect the medium-term economic projections from the OECD and World Bank most recently available at the time of writing, which date to end-2008. These macroeconomic assessments foresaw the deterioration in the global economy particularly in 2009, with a turnaround projected for 2010 and included lower economic growth rates for most countries than in last year's report. Nevertheless, both Organisations have since significantly revised downwards their assessments for world economic prospects and GDP growth in the near term, without, however, providing estimates for the period after 2010 and therefore limiting their direct incorporation in the present base projections.

The medium-term macroeconomic projections were also subject to much lower assumptions on crude oil prices relative to last year's *Outlook*. In the meantime, however, oil prices have continued their descending path, and in December 2008 had reached levels significantly below USD 40 per barrel. Indeed, in January 2009, the US Energy Information Administration of the Department of Energy published short-term projections for crude oil prices indicating lower levels for both 2009 and 2010, compared to those assumed in the December 2008 *OECD Economic Outlook*. Thus, the initial OECD medium term assumptions were supplemented with short term updates for 2009 and 2010 from the US Energy Information Administration which reflects the lower crude oil spot market prices and shows some strengthening of crude oil prices concomitant with the projected economic recovery in 2010. From 2011 onwards, the medium-term crude oil price assumptions remain those used by OECD at the end of 2008 in the context of its economic outlook, with prices moderately increasing to about USD 70 per barrel.

Two elements most directly linked to the economic contraction deserve a more detailed quantitative assessment. As the recession is defined as a decline in real income (or GDP) over a sustained period of time (usually 6 months), the initial baseline projections, as outlined in more detail in the second part of this report, were made subject to a sensitivity analysis. This was based on alternative GDP growth estimates based on the latest short-term updates provided by the OECD and World Bank, complemented by relatively simple and transparent assumptions on longer-term growth (recovery) developments. The strong decline in crude oil (and energy) prices as observed particularly during the second half of 2008 constitutes another highly relevant element of the analysis for agriculture, and something that is, at least partly, directly linked to the crisis: as growth in economies declines and indeed economic output shrinks in a number of countries, energy consumption in general, and crude oil use in particular, decline, putting downward pressure on oil prices. In order to isolate the possible impact of these two elements, the impacts of alternative GDP growth and crude oil price assumptions are assessed individually. These additional scenarios are described in some detail in this section, followed by an analysis of their impacts on the main agricultural product markets in the following section. The sensitivity of agricultural product market projections to higher oil prices than in the current baseline are discussed in Box 2.1.

Some of the wider ramifications for agriculture of the financial crisis cannot be quantified and are addressed more qualitatively in the final part of this chapter. Changes in exchange rate settings are another macroeconomic variable that can be expected to have important implications for agricultural markets, although direct relationships with the evolving crisis cannot always be drawn. These implications were

discussed in last year's edition of the *OECD-FAO Agricultural Outlook, 2008-2017* and are not repeated here.

Lower income growth and different recovery scenarios

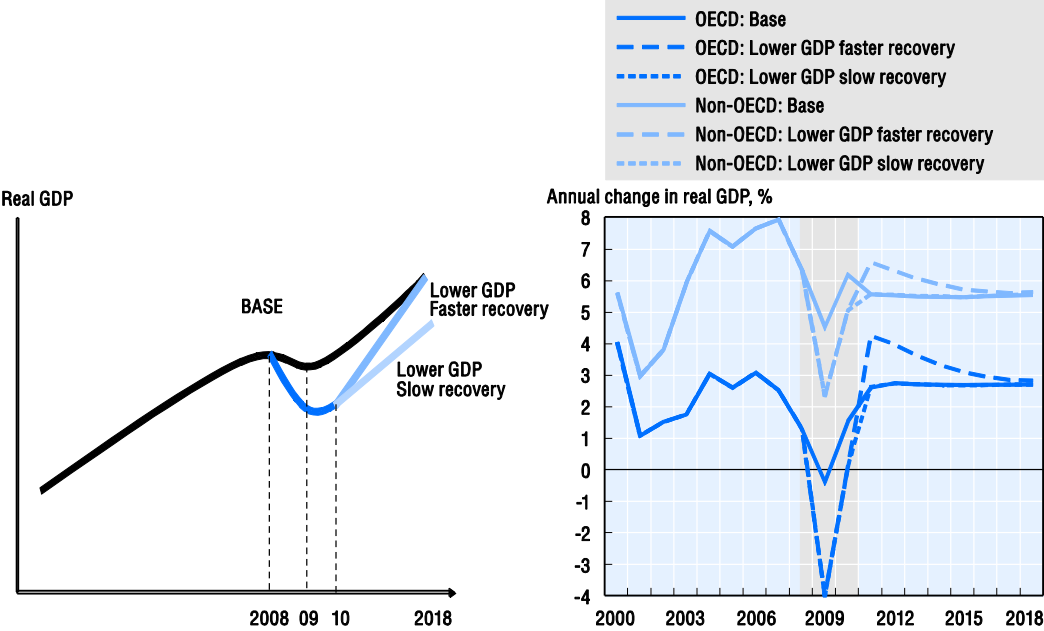
Two alternative scenarios were defined to partially analyse the potential implications of the further deepening of the economic contraction that has taken place in 2009 and which assume a different speed of recovery from recession over the coming decade. Both these scenarios build upon the most recent short term macroeconomic updates published by OECD and the World Bank, and both adjust downwards growth rates in GDP of all countries for 2009 and 2010. Data from the OECD's latest assessment cover the G-7 countries as well as the four major emerging economies: Brazil, Russia, India and China (the BRICs). Adjustments were also made for all other countries based on the World Bank information (Annex A, Table 1). Figures 4.6 and 4.7 in Chapter 4 show the magnitude of these adjustments for major economies and regions.

These data do not provide any information about developments beyond 2010. In order to keep the analysis simple and as transparent as possible, two recovery scenarios are proposed.

The first scenario lower GDP - faster recovery assumes that, following the depressed levels of GDP for 2009 and 2010, incomes enter a rapidly increasing path and quickly approach the levels of the baseline projections. While those levels are assumed to be fully reached only in 2018 - the final year of the projections in this report - incomes are assumed to approach the base levels at a faster speed in the beginning of the 2011-18 period, resulting in only small deviations from the base income levels after about 2015.

The second scenario lower GDP - slow recovery assumes the same level of lower GDP for 2009 and 2010 as in the first scenario. In this scenario income growth rates in each country in the recovery phase after 2010 are assumed to be the same as in the baseline projections, but starting from the lower 2010 levels. As a consequence, income levels never reach those projected in the baseline. All countries are thus assumed to face persistently lower income levels throughout the rest of the projection period, as compared to the baseline projections. The alternative recovery assumptions are illustrated in Figure 2.1 below, with the implied changes in aggregate annual growth rates for the OECD and non-OECD areas shown in the right panel.

Figure 2.1. Stylized depiction of economic downturn and two alternative recovery assumptions relative to baseline (left panel), and aggregate annual income growth assumptions for OECD and non-OECD regions across scenarios (right panel)



It is important to emphasise that the scenarios are not indicative of the full impact of the current global financial turmoil and economic contraction on agricultural markets as they focus on only one indicator, income growth. The results thus only partially illustrate the impact. Furthermore, it should be clear from the design of these two scenarios that neither of them should be read as a worst- or best-case scenario. Indeed, at present it is impossible to precisely assess the path of recovery or even when the world will turn the corner, and thus the final depth and duration of the economic downturn. These scenarios are not, therefore, indications of our expectations of future income growth. While the scenarios are based on lower growth assessments, it should be recalled that the full baseline projections already implied significantly depressed levels of income, when compared to last year’s *Agricultural Outlook*.

It should also be understood that a number of the links between the depressed income levels and agricultural market adjustments are not represented in the Aglink-Cosimo model. For example, the model does not cover the possible (yet unknown) responses in total fuel consumption. To the degree biofuel use and hence biofuel production depends on total fuel use (*i.e.* particularly in countries where biofuel mandates are expressed in fuel shares rather than in absolute quantities), the simulation results therefore likely underestimate the impact on agricultural markets from this source. Similarly, these scenarios do not account for the possible impact of lower incomes on crude oil prices and any implications these may have on agricultural markets.⁶ The scenarios, therefore, should be interpreted as a partial sensitivity analysis for the baseline projections in this report, not as an analysis of the crisis.

⁶ It is interesting to note that while the deteriorated economic prospects should result in lower prices for crude oil prices due to declining energy demand, quotations have actually increased during the first three months of 2009. It is thus obvious that economic growth and prospects, although important, are far from being the only determinant in the price equation for crude oil. Assessing the impact of lower incomes on energy markets would go far beyond the scope of this report.

Main results of scenarios

As has been discussed earlier, income changes are expected to be more important for those agricultural commodities with the higher income demand elasticities such as dairy and meats. These food products form a more important part of diets, along with vegetables and fruits, as per capita incomes increase with economic growth and development. As demand for livestock and dairy products is more reactive to income changes than demand for cereals, grains used for animal feed tend to be more responsive to changes in income than those directed to human consumption. Usually, income changes have a proportionately greater impact in low income countries because of their higher income elasticities and where food consumption forms a larger part of household budgets, compared to many OECD countries where food expenditures, in general, form a smaller part of household budgets, and are usually less responsive to changes in incomes and prices.

The two scenarios of reduced GDP and income growth have the effect of lowering world prices of all the agricultural products in the near term years of 2009-2010, as shown in Figure 2.4 for crop products and biofuels, and in Figure 2.5 for the main livestock products. All product prices drop below their baseline levels, with the impact being particularly pronounced in the short run. While for the slow recovery, prices remain below baseline levels throughout the period, the faster recovery scenario (seeing GDP levels approaching the levels assumed for the baseline) brings all prices back to or around the baseline levels within a few years after 2010 as one would expect from the scenario design. The pattern of adjustment varies between the different commodities under review.

Figure 2.2. Percentage change in biofuel and crop prices with lower income growth in alternative GDP scenarios compared to baseline levels

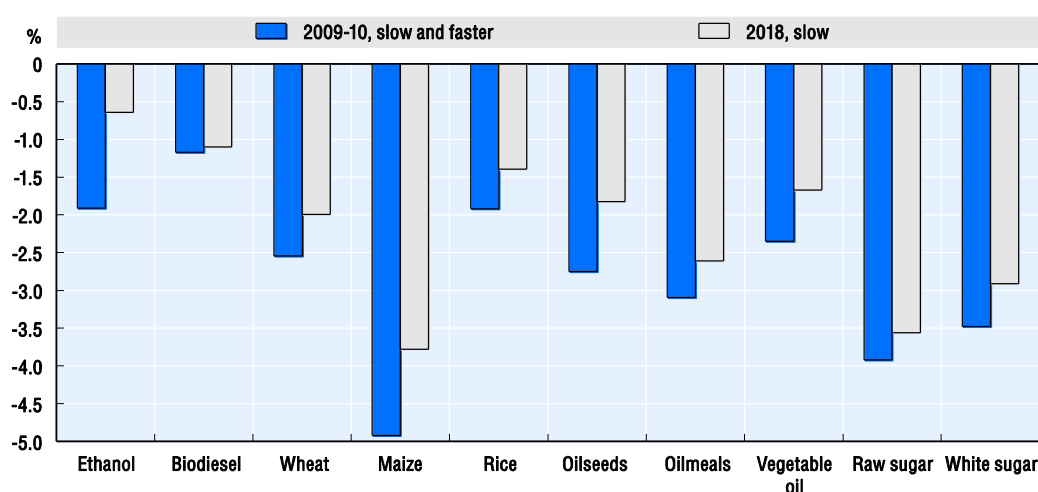
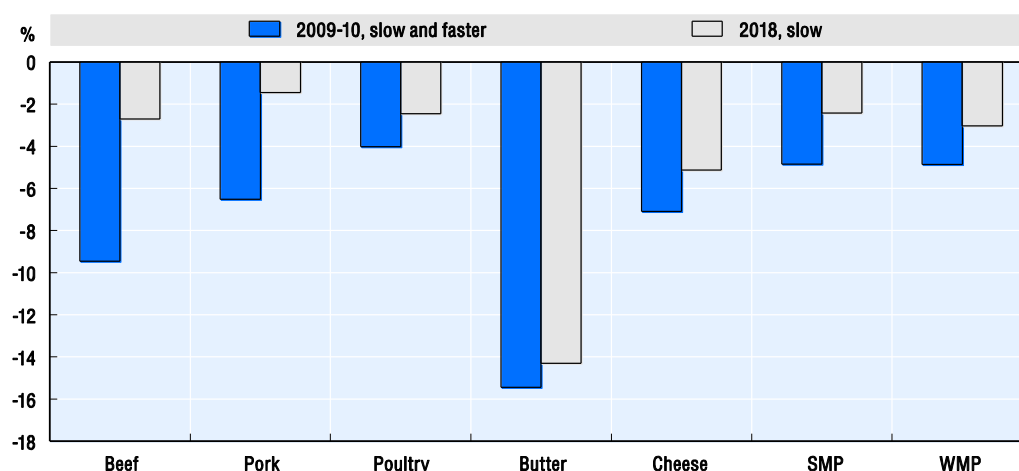


Figure 2.3. Percentage change in meat and dairy prices with lower income growth in alternative GDP scenarios compared to baseline levels



Note: The two scenarios “lower GDP - slow recovery” and “lower GDP - faster recovery” are the same for the 2009-10 period - results are therefore shown only once in the first set of bars (2009-10, slow and faster). Given that markets in the “lower GDP - faster recovery” scenario return to, or approach levels very close to, the base projections, longer-term changes for 2018 are shown only for the “lower GDP - slow recovery” scenario (“2018, slow”).

Little impact on biofuel markets

Given that in many countries biofuel use is largely driven by policy-set mandates, and due to the implicit assumption of transport fuel use being unresponsive to income changes, biofuel market projections are affected only very little by the lower GDP assumptions. In particular the US Renewable Fuel Standard sets lower bounds at the absolute levels of biofuels to be used in each year, and *de facto* puts an upper limit to maize-based ethanol. Given that the mandates - like those in other countries such as the EU - are found to be binding for most of the outlook period, biofuel use and production shows little impact. Lower feedstock prices, however, tend to reduce production cost, resulting in slightly higher biofuel output in 2009 and 2010 notably from sugar cane (Brazil), wheat (Canada) and particularly vegetable oil (EU), and causing slightly lower biofuel prices. Increasingly binding mandates result in quantities to remain largely unaffected in later years, but prices particularly for biodiesel remain below their baseline levels unless incomes return to their higher levels.

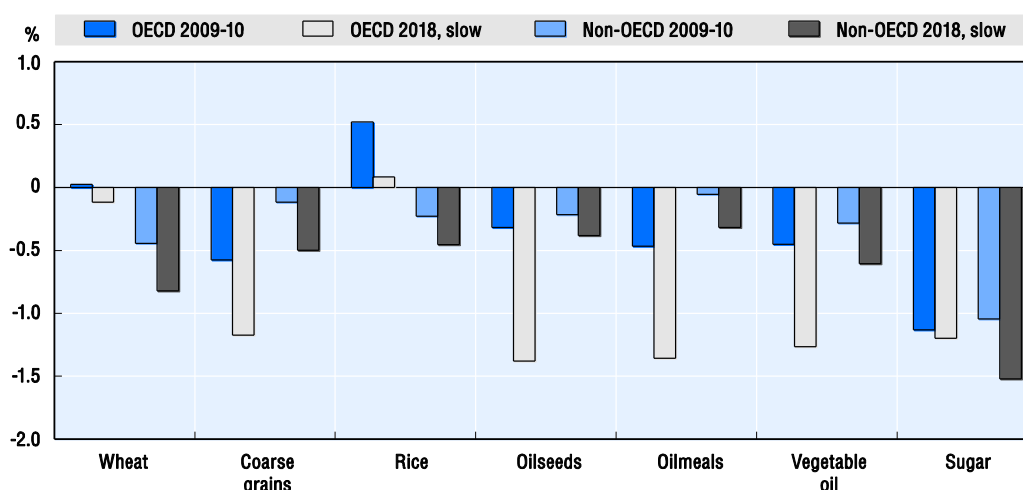
Crops affected moderately, but more than biofuels

As outlined above, food consumption of crops is much less income sensitive than that of livestock products, and so the consumption of food grains - wheat and particularly rice - responds very little. This is true for non-OECD regions, but even more so within the OECD where rice use indeed slightly increases with lower incomes. Income elasticities for vegetable oil product are higher than those for cereals in both developed and developing countries, and so vegetable oil use for food responds more significantly - while the use for the production of biofuels slightly benefits from lower vegetable oil prices. Feed grains are affected by the stronger impact on meat and dairy markets, and in fact feed use of both wheat and coarse grains shows a stronger response to lower incomes than the food use of these commodities. Particularly in many developing countries, sugar clearly represents the most income sensitive crop product, competing with HFCS in food and beverage preparations, and in consequence sugar consumption both in the OECD and elsewhere declines by more than 1% relative to the baseline in the first two years, and by even more than that in later years if GDPs are persistently lower than in the baseline (Figure 2.4).

These impacts on crop consumption, while all remaining relatively modest, tend to become more pronounced over time if GDPs persist to remain below baseline levels (slow recovery assumption), as production responds with lower output to the reduced incentives and price effects hence become smaller over time. If, in contrast, GDPs are assumed to return to their baseline levels (faster recovery scenario), both consumption and price levels return to the levels projected in the baseline of this outlook.

It is worth noting that the impact particularly on wheat production is also higher in OECD countries. This result is primarily due to the fact that yield responses are higher in developed as opposed to developing countries since variable inputs are applied, and can be adjusted to affect yields. It is also a fact that price responsiveness in these countries is higher. Wheat production in OECD shows twice the supply response to the lower GDP, slower recovery scenario than does the non-OECD area. This higher responsiveness of OECD countries was also demonstrated as its production responded most to the high grain prices of 2008.

Figure 2.4. Changes in consumption of crop products in OECD and Non-OECD countries due to lower GDP, relative to baseline projections



Note: "2009-10" and "2018, slow" refer to the average changes in 2009-10 (both "lower GDP - slow recovery" and "lower GDP - faster recovery" scenarios) and in 2018 ("lower GDP - slow recovery" scenario). See note to Figures 2.2 and 2.3 for more details.

Livestock products are more sensitive to lower incomes

Compared to cereal and oilseed markets, those for livestock products are much more sensitive to changes in incomes, particularly in the short run, consistent with generally higher income elasticities for meat and dairy products and longer production processes for many of the livestock products. Within OECD countries, this is particularly true for beef, pork and cheese, whereas consumption of poultry meat - a relatively cheap type of meat - in that region shows only little reduction. Similarly, the consumption of butter and milk powders changes only very little in the OECD, caused again by low income responsiveness but also by significantly lower prices dampening the income response. In fact, the much lower butter prices tend to even slightly increase OECD butter consumption.

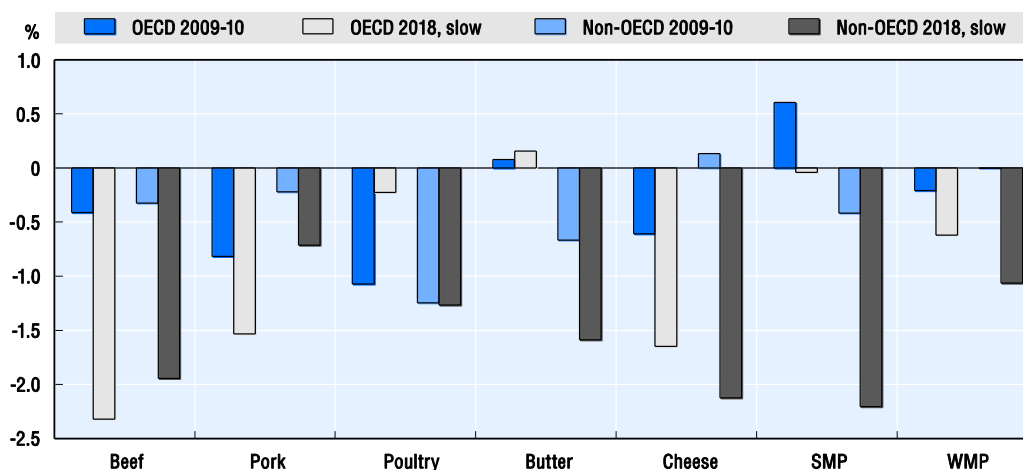
Consumption particularly of dairy products is affected much more significantly outside the OECD area. Most notably, the strong impact of lower GDPs over the entire projection period on international cheese and particularly butter markets under the slow recovery scenario stems to a large extent from a collapse of imports by the Russian Federation. Russia is the largest butter and cheese importer and the key player on international markets for these products, but GDP prospects have been revised strongly downwards for this country. Accordingly, consumption in Russia is heavily impacted and imports contract

by three-quarters for butter and by half for cheese, resulting in significantly lower cheese and particularly butter international prices. However, the design of the slow recovery scenario assumes a stable deviation of GDP below the baseline level after 2010 which may be considered rather pessimistic. This underlines the importance of economic developments for the dairy outlook as income growth remains one of the key drivers underpinning international dairy markets.

Beef consumption, too, responds relatively strongly in non-OECD countries, given high income elasticities and a significant reduction in supplies in the longer run, while in the initial years the longer production cycle results in price changes to be much stronger than changes in production and consumption quantities. The much shorter production cycle particularly in poultry results in almost immediate production cuts, causing prices to fall significantly less than those for beef or even pork, and hence putting further pressure on poultry consumption in developing countries.

Consequently, prices for livestock products are affected more significantly than those for crops. Butter prices in particular are seen lower by nearly 16% for 2009-10, and by 14% by 2018 in the slow recovery scenario, compared to the baseline projections. Price effects for other dairy products range from 5-7% lower in the short term, and 2-5% in the medium term if income levels persist to be lower than in the baseline. Those for meat products are in a similar range with 4-9% lower prices in the short, and 2-3% lower prices in the longer run.

Figure 2.5. Changes in consumption of livestock products in OECD and non-OECD countries due to lower GDP, relative to baseline projections



Note: "2009-10" and "2018, slow" refer to the average changes in 2009-10 (both "lower GDP - slow recovery" and "lower GDP - faster recovery" scenarios) and in 2018 ("lower GDP - slow recovery" scenario). See note to Figures 2.2 and 2.3 for more details.

Conclusions

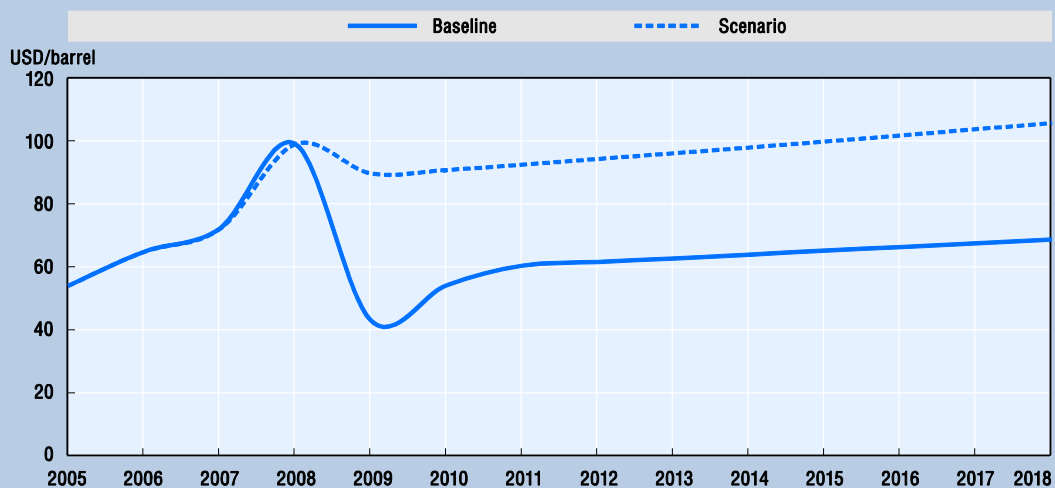
A critical issue surrounding a deeper and longer lasting recession is that of food security, an issue for which the situation in cereals markets is a key factor, particularly for the lower income and poorer developing countries. Low incomes imply less ability to afford the purchase of basic needs such as food, expenditures which represent a large proportion of disposable incomes. It is difficult, with the tools available, to address the full implications on food security of a deeper and longer lasting recession, since economic cycles/recessions themselves have differential impacts across the income distribution of the population. Evidence suggests that the incomes of the poor are disproportionately affected by recession – a factor that cannot be addressed in this analysis, but that has substantial effects on the well-being of certain population groups, if less on markets.

Box 2.1. The sensitivity of the projections to changes in oil prices

The strong decline in crude oil (and energy) prices as observed particularly during the second half of 2008 constitutes another highly relevant element of the analysis for agriculture, and something that is, at least partly, directly linked to the crisis: as growth in economies declines and indeed economic output shrinks in a number of countries, energy consumption in general, and crude oil use in particular, decline, putting downward pressure on oil prices. A downward correction seemed likely after prices peaked at more than USD 147 per barrel in July 2008, but thus has now been overtaken by events of the unfolding economic crisis. In terms of analysing the sensitivity of the projections to changes in key assumptions, the oil price affects both agricultural production and consumption decisions. It is therefore pertinent to examine the sensitivity of the commodity projections to alternative oil price expectations. This analysis is described and discussed in this box.

In order to allow for a quantitative assessment, a scenario has been designed for comparison with the baseline projections based on changing the oil price assumptions to the higher levels used in last years' report *i.e.* the 2008 edition of the *OECD-FAO Agricultural Outlook*. At that time, the oil price was assumed to grow from USD 90 per barrel in 2008 to USD 104 in 2018, as represented in Figure 2.6.

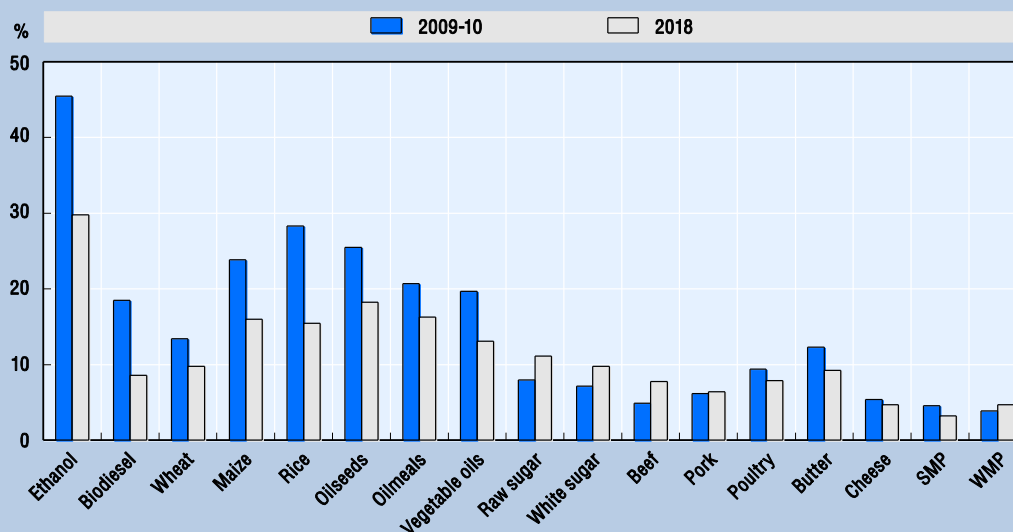
Figure 2.6. Baseline and alternative assumptions for crude oil prices



As in the case of the income scenarios, a number of caveats are appropriate. First, as the model implicitly assumes transport fuel consumption to be unresponsive to price changes, in most cases, the simulated impact of changes in the oil prices is likely to underestimate the actual impact on biofuel consumption channelled through total fuel use - except where the latter is fixed by quantitative mandates. Second, higher oil prices themselves have an impact on economic growth, and, as in the inverse case of the income scenario, this impact cannot be captured with the existing tool. Finally, as for the use of many other models, the Aglink-Cosimo results of a major shock such as the doubling of oil prices in the early years of the projection, or even an increase by 50% towards the end of the simulation period, obviously need to be read with care. As a consequence, the results of this partial analysis should be interpreted as indicative.

As is evident from the Figure 2.7, the impacts found in this analysis are much larger than those for lower incomes - this is due to both the relative size of the shock and the importance of the different driving factors on agricultural markets. Another result that becomes clear from Figure 2.7 when compared with Figures 2.2 and 2.3 is that crop prices show a significantly higher sensitivity to oil price changes compared to livestock products, while the opposite was true for GDP shocks. Given the high energy share in total production costs particularly for crops through fertiliser, chemicals and fuel prices, energy prices have long influenced the supply on agricultural markets. With the emerging biofuel sector, an additional link is strengthening through the demand for biofuel feedstock commodities, particularly for cereals, vegetable oils and sugar, but indirectly also for other crops competing for the same land. Due to the increasingly mandate-driven dynamics in the biofuel sectors of many countries, however, this element today is less pronounced than would be under more market-driven conditions.

Figure 2.7. Impact of higher oil prices on commodity prices compared to baseline (percentage change)



Many biofuel mandates are less binding in the early years than towards the end of this outlook's baseline. In consequence, while higher oil prices would result in global ethanol and biodiesel use to be about 10% and 20% higher than in the baseline, respectively, this effect becomes very small in 2018. The consumption impact for ethanol - less bound by mandates than biodiesel on a global level - is further dampened by significantly higher ethanol prices. Confirming earlier analysis, the impact on ethanol prices is roughly half the change in crude oil prices

Despite the higher biofuel use and production particularly in the short-term, the major link driving up crop prices remains through production costs. With much higher crude oil prices, all crop prices would follow substantially different paths than in the current baseline over the projection period to 2018. The growing importance of binding mandates, together with the fact that the changes in oil prices are larger at the beginning than towards the end of the simulation period, results in many of the price effects to be smaller in the longer term (+10 to +18% for cereals and oilseeds) than in the short-term (+13% to +28%). The reverse is the case for sugar where production adjustments with perennial crops take longer to work through and amount to 10-11% by 2018 (Figure 2.7). Generally speaking, today higher oil prices would mainly result in lower crop production because of their production cost effect, and then reallocate from food to fuel production. Both these effects result in lower food consumption of basic agricultural commodities.

In general, the impact of a higher crude oil price on the livestock sector is much smaller than for crops. The oil price affects livestock markets through both higher cost of energy use especially for energy and capital intensive production systems as found, for example, in poultry production, and through the impact on feed ingredient costs. On the other hand, the higher cost of feedstuffs is to a certain extent mitigated by increased availability of distilled dry grains (DDGs) a by-product of bioethanol production.

The increased cost of meat production results in reduced global meat production. Generally, the decrease of production is rather small, not exceeding 3.5% in any of the years of the projection period and for each of the different meat types. The largest impact is on the energy and feed intensive poultry sector (2-3% reduction in output compared to the base), and small for the less energy and feed intensive ruminant sector (0-1.5% reduction compared to the base). Global milk production declines more in the near term years due to lower milk yields, whereas the reductions in following years are increasingly attributable to lower cow inventories.

The decline in production translates into increased world market prices for meat and dairy. The changes in world prices however are quite modest. They are, on average over the outlook period between 4% and 7% higher in any of the years than in the base projections. In the case of butter the price are higher in the range of 16% (in early years) to 9% (at the end of the outlook) underpinned by higher vegetable oil prices which are themselves propelled by higher crude oil prices and biodiesel production.

Effects of the financial crisis on the agri-food sector: views from industry players⁷

The previous section focussed on the sensitivity of the baseline projections to lower income growth in two stylised scenarios: real income declines and higher oil prices. This section examines in more detail some of the broader issues arising from the financial crisis, such as credit constraints in domestic and international trade as well as the consequences of income declines on demand and prices. Furthermore it takes a wider approach in terms of activities covered by including both the upstream and downstream portions of the agri-food sector.

Over the past decades, the agri-food sector has become not only more globalized through international trade as it sources and sells across the globe but also more integrated into the modern financial system. Consequently it is more subject to the exogenous fluctuations originating in the macro-economy. Impacts on the specific agri-food sectors have now come to depend on the strength and depth of its linkages to the financial system and the global economy

Surveying industry views on the impacts of the financial crisis

At present there is very limited data available to assess the impacts of financial crisis on the agro food sector. To fill - even if only partially - this information gap, the OECD Secretariat carried out structured interviews with over 45 firms/professional associations for the different activities along the agri-food chain as well as with banks dealing with trade finance and agriculture. This information was supplemented with information from publicly available annual reports, newsletters from firms and government websites. Attempts were made to interview players from as many different geographic areas, sub-sectors and activities as possible.⁸ The questions asked of participants focussed on the effects of the economic downturn, indirect or direct credit constraints as well as specific questions on trade and trade credit impacts of the financial crisis. Interviews with banks provided insights into credit allocation behaviour. Results should be considered as simply indicative of present tendencies and not necessarily applicable to all agri-food sectors in all OECD or non-OECD countries.

Impacts on the agricultural input industry

Demand for agro-chemicals is expected to remain weak at least through the first half 2009 and then pick up through 2010, according to the multinational input supplier firms interviewed. This could indicate a loss of confidence by farmers in future earnings as these types of inputs tend to move with expected returns. The primary cause for the decline in sales is the global downturn and not farm credit availability. The IFA (International Fertilizer Association) expected demand to remain weak through early 2009. For the current crop year demand is expected to be down by 2.2%.⁹

Access to credit was also not seen as an obstacle to equipment purchases in North America according to the AEM's (Association of Equipment Manufacturers) survey, of 2009. Sales have however declined by 24.9% in the US and 9.7% in Canada, in a year-on-year basis as of February 2009.¹⁰ This is a significant

⁷ In this survey agri-food refers to the entire agri-food chain from inputs to retail sales.

⁸ The non-OECD countries included Argentina, Brazil, Chile, South Africa, Ghana and Kenya.

⁹ According to the IFA declines in crop prices have their greatest impact on potash and phosphates fertiliser whose demand is expected to fall by 4.7% and 8.5% respectively, while nitrogen demand should rise by half a percent.

¹⁰ AEM, Association of equipment manufacturers includes over 800 manufacturers of agricultural and construction equipment in North America and includes foreign firm branches. Data from Ag Flash Reports- retail sales, February 2009, % changes are calculated on a yearly basis. For detailed survey results see: www.aem.com

change from the double-digit sales increases over the past two years. In those years, sales were fuelled by increased commodity prices and rising net farm incomes, which have now reversed.

Taking a more global perspective on sales, specific firms have seen sales fall in certain non-OECD markets due in part to the tightening in the access to credit. Importing firms are curtailing, delaying and cancelling orders to deal with credit limitations, whenever this is feasible. This has been the case in Argentina and Brazil where orders have been cancelled due to reported credit constraints. For instance, a major agricultural machinery manufacturer, AGCO, expects sales in Brazil to be 20-30% lower this year, due to tight credit and a weaker local currency making imports more expensive.¹¹ It is difficult to disentangle which sales changes are due to changed economic conditions or credit constraints, which were important for countries like Brazil in late 2008.

Impacts on farmers

Downturn in farmer confidence

Recent rural confidence surveys conducted by the Rabobank, for the United States, Australia and New Zealand indicate that farmer confidence has deteriorated over the past year and even in the recent quarter reflecting the continued deterioration of the global economy, and commodity prospects. The future negative impact of the global financial crisis rather than a reflection of own experience appears to dominate sentiment. About 58% of Australian and 29% of New Zealand respondents judged that the worsening of overseas markets and economies would have serious impacts on future sales and incomes *via* both lower prices and their volatility as demand dampens. In both countries, farmers are streamlining operations and finding cost cutting solutions to deal with the new conditions. Credit availability was not considered to be a significant cause of concern in either Australia or New Zealand.

In the US, survey results suggest that over two thirds of farmers, regardless of region, revenue group or farm size, expect a decline in incomes for 2009. This is in part due to global economic conditions placing downward pressure on commodity prices. In response, farmers are adjusting behaviours in terms of investments and about half have now implemented, or plan to invest in, risk management or marketing strategies. Even in terms of machinery purchases, there appears to be an increase in purchases of used machinery, though this market has also softened of late.

Farm credit situation

According to farmer/co-operative associations, in Western Europe in particular, there appears to be little or no impact of the financial crisis on credit availability to the sector, given its generally low debt situation. However conditions of access to credit are becoming tighter as in other sectors. This is being evidenced through increased demands for additional collateral, more limited repayment periods and/or increased financing costs. Most credit to agriculture is provided to meet operating expenses due to the lag between planting, harvest and final sales.

In the US, credit availability is on trend with other years. However a most significant development in the first quarter of 2009 has been the increased demand for short-term finance for operating expenses, which corresponds to periods of declining prices and incomes as cash-flow falls (Board of the Governors Federal Reserve, 2009). In addition there have been some signs of increasing delinquency rates and charge-offs on agricultural loans implying an erosion of loan quality (Henderson, 2009).¹² The recession now is

¹¹ Brazil Ag Machinery Sales Slow in January, Kieran Gartlan, DTN, 11 February, 2009.

¹² Delinquency rates on agricultural loans climbed steadily in 2008, rising by 30% during the year. www.federalreserve.gov/releases/charge-off.

beginning to generate a number of concerns in the banking sector with respect to loan availability, costs of funds and creditworthiness of borrowers and is leading to increased collateral requirements and reduced loan maturities (Henderson, 2009). This is all the more so the case as farmland values are the main source of collateral and these started to decline in the fourth quarter of 2008. If the recession lingers and agricultural prices weaken further, asset values such as land may begin to decline, and the credit markets for agriculture tighten further.

For many EU countries no significant declines in credit availability were signalled as of the fourth quarter of 2008. According to farm co-operative associations such as Copa-Cogeca in Europe as well as those of individual countries, credit conditions for the agriculture sector are relatively robust, compared to other sectors of the economy. Producers in most major agricultural co-operatives have no difficulty in obtaining bank credit at least for domestic activities. In this case, legal contracts using output as collateral back up the funding arrangements. This is because it is easy, relatively speaking, to recoup funding on the product when the contracts are between firms in the same country. Collateral requirements have been increasing and standards for allocating credit have however tightened substantially since the beginning of the year. This evaluation needs to be nuanced by country and by sector situations as there may be substantial variations among them. Due to the tight credit situation, many agri-co-operatives are putting a hold on investments in additional processing and storage facilities. Though no figures were given, the changes in decisions were noted to be substantial. Banks were judged often to be overly cautious some of the respondents suggested. This confirms what banks themselves say about their credit allocation decisions - avoid or minimise risk.

Agricultural Policies in OECD Countries: Monitoring and Evaluation 2009 suggests that regardless of the evolution of the volume of credit to the agri-food sector, lenders are expected to require higher levels of collateral for a given loan. However for the moment the view held is 'there are good reasons to argue that the agricultural sector in most OECD countries is in a good position to confront this crisis, both relative to the past and relative to other sectors (OECD 2009b).

Non-OECD perspectives

According to producer associations, traders and banks in Argentina, credit availability for cereals, oilseeds and wine is not an issue as in general the industries self-finance their operations. However, due to low prices and conflicts over government policies, traders as well as certain downstream agri-food firms are experiencing difficulties in acquiring necessary inputs since farmers are reluctant to sell their output and only as needed to meet expenses. Credit constraints are, however, severe in the dairy sector and this is having serious financial consequences on firms. It is unclear whether this is a direct consequence of the global financial crisis.

Tight credit for farmers last fall in Brazil forced the government to step in to ensure that funds are available for the planting season, even though only about a third of agricultural credit originates from banks. The government increased the amount of demand deposits that banks must lend to the agricultural sector from 25-30%, temporarily.

In Chile, the fruit producer associations do not have credit availability problems at present. However, there is much uncertainty and concern for future demand given the economic recession in their principal trading partners, the EU and the US. A similar situation was reported by some producer groups in South Africa.

In most developing countries the use of bank loans in agriculture is not common. When loans are given they are for very limited time periods with strict selection criteria. In certain regions, loans from input suppliers and traders are used by small and medium farmers. However, if input suppliers are also

relying on credit, a tightening of their financing will assuredly affect those to whom they are selling/lending.

In the East Africa region, for countries such as Tanzania, Rwanda, Zambia and Mozambique, the financial crisis has not generated any notable liquidity constraints. Most financial institutions are savings banks and these give few loans to the private sector, preferring to lend to government agencies and institutions. Banks give loans to farmers after harvest via warehouse receipts which permit farmers to better manage the sales of their crops.

Bankers' views

Some bankers were suggesting that an important consequence of the financial crisis will be a structural change in bank lending be it for trade or other investment purposes. Greater emphasis will be placed on income statements and repayment capacity and the extent to which firms are leveraged as well as the market risks of their main sector operations. For many firms, the effects of these changes will only begin to be seen in the coming months as loans come due and renewals under stricter criteria are applied.

Interviews with major banks involved in trade finance found that credit was being allocated in a more selective manner as market risks rise. For instance, no new clients are being taken on unless these are subsidiaries of existing clients, and an increased level of collateral is required for loans for all. Even the very big firms/traders with longstanding large credit lines are now subject to increased pressures as credit lines are subject to greater cost or collateral variations, even on a day-to-day basis. In addition, the costs of credit are rising and several layers of credit guarantees may be required for any loan. Though higher pricing can in part take this into account, some banks appeared more risk averse than others with respect to certain elements, such as institutional and country risk. These risks appear to have risen in importance after recent bank failures in OECD countries.

Another problem arises when destination countries for exports have weak legal systems. In these cases, it is often difficult or impossible to obtain compensation or even make claims, making the risk too high in spite of higher fees. In certain cases, banks are extremely reticent about credit lines for specific export destinations, such as Ukraine, Russia and certain Baltic countries. It is not known whether this is a sectoral issue particular to the agri-food trade or a more widespread one affecting all trade with these countries. For certain emerging and developing countries, the constraint is exacerbated due to lack of support from their own credit institutions and the inability to move successfully in the sea of trade finance documentation. In a context of weakened economic growth and financial turmoil, banks are shying away from all but the most secure transactions to avoid adding risk to their balance sheets. Again, not all banks approach trade finance the same way but the trends are clear; more collateral/own equity and additional required documented guarantees both for the importer and exporter so that the final transaction may have several layers of guarantees.

Firm reputation is a basic ingredient for any credit evaluation, and thus in many instances small firms are reported to have no more difficulty obtaining credit than large ones. However, in a recent bank survey by the IMF and BAFT (Bankers Association for Finance and Trade) on private sector credit developments for trade, indicated that as costs of trade credit are rising the demand for trade credit by small firms may be reduced [Dorsey, 2009]. The same survey found that in commodity trade both country risk and the type of trade coupled with fluctuating prices and long shipping times, has meant that banks are now shying away from these operations.

Agri-food trade

From this preliminary analysis and anecdotal evidence it appears that trade credit constraints are affecting the agri-food sector and, in a number of instances, quite severely. Difficulties in obtaining trade credit/finance for transactions between non-OECD and OECD countries is frequently reported, such as for Russia and Ukraine. However, even transactions between OECD countries and within the EU and within a given country are experiencing credit access difficulties. In part this is due to the general lack of confidence and increased caution on the part of credit providers that the present financial turmoil has generated.

For firms that rely on exports of bulk commodities or semi-processed products for most of their earnings, the trade credit issue is considered critical. With risk perceptions in a state of flux due to the market turmoil, demanding counterparty guarantees are now required of importers and exporters and this is increasing transaction costs and reducing trading opportunities. Risk for a given transaction is now not only a function of a firm's creditworthiness but also of exchange rate and institutional risk, a belief confirmed by bankers' responses. Exchange rate risk is of course a risk firms and traders must bear, but it may affect the banks evaluation of the value of a transaction. While secondary markets for these risks exist, the recent financial market turmoil and extreme exchange rate volatility, has to a large extent dried up their liquidity. Thus as banks do not wish to add risky products to their balance sheets, trade credit is simply more selectively allocated. This was noted by exporters whose traditional markets are now considered more risky destinations. In some instances, exports must now be on a cash basis or not take place at all. This restructuring of credit allocation may also imply that the traditional role of traders with private information on different trading partner creditworthiness will again become important.

Firms which cannot get some ingredients may be forced to shut down temporarily or even exit their business. It has been reported by importers that existing credit line guarantees have increased to an extent that it is literally impossible to import goods. For instance, the inability to access credit for imports has blocked production by agri-food processing firms in number of African countries, even though the firms are financially sound. And similar experiences were noted by certain medium-sized African supermarkets in sourcing from European suppliers.

On the export side one co-operative from Denmark expressed strong concern that trade in dairy and pork exports were being held up due to lack of trade finance in importing countries due to these countries' exchange rate and institutional risks. Tightening of trade credit conditions and availability was felt to be curtailing not only their export potential but also actual export activity, so much so that some even allude to the possibility of having to exit the sector completely. For many small and medium sized firms even export credit insurance has dried up in the present economic context. Difficulty in obtaining export credit guarantees has led to a decline in sales particularly to specific trading partners and already risks the economic viability of the firm.

Impacts on food manufacturers

All multinational food firms interviewed did very well in 2008 in spite of weaker earnings towards the end of 2008. Most expected this weakening to continue in the initial part of 2009 as income continues to decline and pricing strategies come under pressure. Maintaining market share when price becomes a much more significant determinant of purchases than previously was seen a critical to coming out of the recession with limited damage to the balance sheet and brand. This has motivated firms to develop product lines that meet consumers' new demand for higher value.

The most severe impacts of tighter credit along with a decline in demand were noted by the food manufacturing sector. Due to the structural characteristics of the sector, with many small and medium sized

firms, they often have difficulty in obtaining bank credit due to their low levels of equity and liquidity. This situation may force already financially fragile firms to exit, generating further economic consequences. In an internal survey of major European food manufacturing association, 40% of the firms were affected by the downturn, of which 70% were small and medium sized. Over 30% reported that financial guarantees for loans had become a constraint and new credit was increasingly difficult to obtain. However, for the financially robust firms there were no credit reductions.

The financing of transactions between firms as noted previously remains an issue even within a country. This was noted in the UK, where a firm's production can be blocked due to inability to obtain inputs - raw or processed - due to credit constraints. Several firms in other countries, such as Belgium, Italy and Spain, reported similar difficulties. This situation is likely due to the lack of trust and uncertainty now dominating any form of credit transactions and should prove a temporary disruption. Once the balance sheets of firms or their financial conditions are known more normal trading conditions should ensue. Banks can then provide needed credit to the financially sound firms enabling sales and purchases to flow again, even if they are likely to be more rigorous in their evaluation of balance sheets and thus more selective in credit allocation.

A more rigorous evaluation of a firm's financial standing may mean that highly leveraged firms may have difficulties in renewing loans. New firms without reputable credit histories may have to meet much tougher standards in terms of greater collateral, higher cost and shorter repayment periods than was previously the case. This could have implications for the structure of the sector, but it is too early to identify or even speculate on what adjustments may be forthcoming.

Impacts on the food retailing and food service sectors

Both food retailers and food service firms/restaurants in the OECD area are being affected by the economic recession as consumers reduce spending and reallocate expenditures across food products and services. This is increasing competition among firms as they attempt to maintain market shares.

Retailers have observed a move by consumers toward the purchase of lower priced products that offer almost equivalent product attributes. Retailers' private label products have benefited from a greater cost consciousness among consumers. This trend began over a decade ago and may only be accelerating due to the recession. While certain branded product categories remain strong, a number of brand name manufacturers have also begun to modify their offerings in response to consumers' price concerns. While quality continues to matter to consumers they appear to be making more trade-offs among product attributes as they reduce total spending.

Restaurant meals are generally thought of as a discretionary expenditure. In France, Italy, the UK and Australia, reductions are expected in away from home meals are expected. In the US, according to the restaurant association, there has been a small decline in expenditures in real terms, but market shares are shifting towards full service family and fast food chains, to the detriment of upmarket restaurants.

Summing up

Players in the agri-food sector, are experiencing both demand and credit effects of the financial market turmoil though the intensity varies across activities along the chain. In general, the agri-food sector is considered to be more resilient than others, but risks may intensify should the financial crisis and recession be prolonged. Trade credit availability was a significant problem for manufacturers, processors and producer cooperatives involved in trade.

Agricultural firms and producers in the OECD area generally expect a worsening of future sales prospects and prices over the near term due to the deteriorating global economic conditions and sharp fall

in trade. Firms that are more capital intensive and rely more heavily on external finance could be more seriously affected if the recession in the OECD area and general economic downturn elsewhere is both deeper and its duration prolonged. While credit availability for farmers in most OECD countries is not yet constrained as their financial situation coming into the outlook has been buoyed by high commodity prices, despite rising input costs, in the past two years, there is a reported tightening of credit standards, increased collateral demands and shorter repayment periods by banks.

Though demand in the downstream industries is slowing somewhat, most firms consider that demand for their agri-food products will be less affected than that for products in the non-food sector. Tighter access to credit was signalled by most firms in the downstream portion of the sector as an emerging problem. Credit conditions are generally perceived to be deteriorating and in many cases restricted access to credit is creating blockages along the chain which is limiting the ability to source raw materials or to move products through different stages of production. But this may be a temporary situation until firms' balance sheets positions are known and interbank lending and transactions recover.

Since credit allocation by banks relies heavily on an evaluation of the firm's ability to repay the loan, small and medium-sized firms are reported to be experiencing the greatest difficulty in getting credit due to their limited equity. Highly leveraged large firms may also now be under greater scrutiny. It is too early to fully understand the implications of changing risk evaluations in credit allocations for the food sector.

Regardless of the position in the food chain, firms involved in trade, imports or exports or both, repeatedly and emphatically listed trade finance constraints as the most binding to their business, due to its impacts on sales. Indeed, trade finance constraints may be exacerbating any downfall in demand and may be putting in peril the economic viability of firms. In a world of global supply chains and distribution systems such constraints may be a determinate factor for the financially fragile firm's survival in the short run. If credit constraints, which affect small and medium firms more severely than larger firms, persist they stimulate structural changes in the industry composition as well as in firms themselves.

The foregoing analyses of the financial crisis effects on the agri-food sector have reflected the short-term consequences of the credit constraints and of the economic downturn. However, recovery in GDP growth rates and international trade expected in 2010 and continuing thereafter through the projection period, should generate a more favourable economic environment for agri-food firms in terms of demand. In addition, if as expected the present tight credit situation loosens as the banking sector resolves its balance sheet issues and resumes lending, then firm activity should pick up both domestically and in terms of international trade. It is, however, likely that the financial crisis will have generated structural changes in credit allocation strategies reflecting a different view of risk taking than before. This may increase required assurances in all lending transactions as has already been indicated by bankers. Over the medium term firms may need to learn to re-adapt business strategies to this evolving credit environment.

Agricultural futures markets and the speculative activity

Another consequence of the financial market turmoil over the past 18 months has been the significant decrease in equity market values, which some suspect has affected the futures market activity of the large long traders. Last year's *Outlook* signalled an increased use of futures markets by non-commercial traders compared to previous periods with a rise in total contract volumes and their share of contracts. As volumes have declined the shares of non-commercial open interest long contracts have also fallen except for sugar Table 2.1. The share of index trader contracts (long) with respect to combined futures and options contracts has, however, increased for corn, wheat and soybeans.

Table 2.1. Futures market activity: total volume of open interest contracts and distribution over commercial and non-commercial traders (Chicago Board of trade and New York Board of Trade)

Futures	Corn	Wheat	Soybean	Sugar Futures
Total open int.				
2005	657 417	222 752	272 127	400 084
2008	1 452 992	449 237	596 447	979 085
2009	812 240	305 491	322 897	660 712
% Commercial				
2005	61.6	55.4	59.5	43.8
2008	45.6	48.6	42.9	55.5
2009	50.0	48.0	47.0	50.5
% Non-comm.				
2005	16.9	28.0	19.9	34.8
2008	43.2	42.3	46	33.7
2009	36.2	42.8	39.9	37.4
% index traders –long				
2008	20.2	36.2	23.9	31.1
2009	21.7	40.6	24.9	24.0

¹Source: Commodities Futures Trading Commission (CFTC), www.cftc.gov, *Commitments of traders Long Report: 25/03/2005, 25/03/2008, 24/03/2009* for total open interest contract volume, and % of commercial and non-commercial long contracts.

²CFTC, *Commitments of traders, futures and options combined, supplemental report, 25/03/08,24/03/2009*.for index-trader positions.

³CFTC, *Commitments of Traders, NYBOT, 25/03/05, 25/03/08, 24/03/09* for Sugar.

The role of speculators in futures markets has gained renewed interest in political circles¹³. Frequently questions arise as to whether or not there might be excess speculation in these markets and if so, can it affect market prices.

Some observers contend that increased participation by speculators in futures markets has increased so markedly in recent years, that it is now excessive and could be a cause of the very recent price gyrations experienced in basic food commodity markets. However it is also probable that their increase reflects expected profit opportunities that originate in the commodity market fundamentals themselves and are signalled to them by hedger activity. Simply put, the increase in speculative activity is due to expected changes in market fundamentals and not vice versa (Working, 1960; Irwin *et al*, 2008; Sanders *et al*; 2008, Irwin 2009).

Does the increase in the number of non-commercial long contracts imply that there is excess speculation? Futures markets are mainly hedging markets thus there would be unnecessary or excess speculation if the contract volume held by speculators exceeded the amount necessary to meet hedging needs of commercial traders (hedgers). Workings' T-statistic is used to calculate the excess speculation in futures markets from data provided in the official COT (Commitment of Traders) reports of the CFTC (Commodity Futures Trading Commission, www.CFTC.gov).¹⁴ A value of 1 for the T-statistic would indicate that speculative activity was the minimum necessary to meet needs of hedgers' activities, both long and short. Values above 1 indicate an excess of speculation, but as noted by Working, this technical excess is economically necessary for a well-functioning market (Sanders *et al.*, 2008). From previous

¹³ Speculators are defined as non-commercial traders, that is, those who enter the market without having an underlying risk position associated with futures. Since there are limits on the non-commercial trades, commercial traders have no interest in being classified as non-commercial and thus the non-commercial category can be considered as those not having any underlying risk to hedge. The debate focuses on the commercial definition which might include some form of underlying financial risk unrelated to commodities.

¹⁴ Details on data assumptions and method are available from the OECD Secretariat.

studies, including some dating from the 1950s and 1970s through to 2008, the value of this indicator statistic has ranged from 1.05 to 1.89 for a variety of commodities (Working, 1960; Peck, 1982; Leuthold, 1983; Sanders *et al*, 2008). These values were obtained before the entry of large non-commercial long traders, such as index traders.¹⁵

Working's T-statistic is calculated from 1-1998 through 3-2009 for wheat-CBOT, corn, soybeans, sugar and crude oil and results are shown in Table 2.2. They are all in excess of 1 but appear to be in line with previous periods as well as findings of other research (Sanders, 2008). A maximum value of 1.27 is found for wheat, but for the period 1998-2002 before the entry of large speculative traders. A closer look at the values indicates that during the recent commodity price increase, 2006-2008, this indicator was lower than in the 1998-2002 period.¹⁶ Values calculated for each year also find that they are lower in the recent 5-year period than in the previous one. It does not appear that speculation has been excessive in the markets examined given available data and Working's statistic.¹⁷

Table 2.2. Working's T-statistic as a measure of excess speculation

Time period	Corn	Crude oil	Soybeans	Sugar	Wheat
1998-2009	1.13	1.08	1.14	1.08	1.23
1998-2002	1.13	1.04	1.15	1.07	1.27
2002-2009	1.13	1.10	1.13	1.09	1.20
2006-2008	1.11	1.12	1.13	1.10	1.20

Note:

1. $T = 1 + (SS/HS+HL)$ if $HS \geq HL$ and $1 + SL/(HS+HL)$ if $HS < HL$, SS= Short Speculators, SL=Long speculators HL=Long Hedgers, HS = Short Hedgers,

Source: OECD Secretariat.

Some observers do suggest that speculators were responsible in part for recent price rises and not simply to underlying market fundamentals (Robles *et al.*, 2009, Masters, 2008). There is almost no evidence that speculative positions in futures markets directly affect prices, though some have found some evidence over specific intervals for certain commodities. Very preliminary in house econometric analysis also does not indicate any statistical link between speculators positions and spot prices. Other recent studies have found mixed results on directions of causation (EU, 2009). The topic certainly merits further research to avoid *a priori* judgements in any policy decisions regarding the operation of these markets.

¹⁵ There are no statistical criteria to determine different degrees of excess speculation.

¹⁶ The calculation of the T statistic relies on the accuracy of the classification of traders in the COT reports and has been discussed both at present in the past by researchers. A trader is commercial if he using the futures market to hedge an underlying product. However the entry into the futures markets by banks/financial operators who operate to hedge against their 'underlying swaps' or OTCs or indices are non-commercial traders.

¹⁷ For further information on calculations and results see the website www.agr-outlook.org

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CHAPTER 3

CAN AGRICULTURE MEET THE GROWING DEMAND FOR FOOD?

There is unprecedented international interest in the issue of food security. This is not surprising given the total number of undernourished people in the world reached 963 million in 2008, nearly 15% of the world's population. The World Bank's 2008 World Development Report launched this revival by calling for greater investment in agriculture in developing countries if the goals of halving extreme poverty and hunger by 2015 are to be realized. An FAO conference in 2008 stressed that food security was one of the biggest challenges of the century, noting that increased agricultural investment and enhanced productivity was crucial. The 2008 G8 Summit in Japan called on agricultural ministers to draw up concrete proposals on world food security and a UN Task Force on Global Food Security was set up to promote a unified approach to emergency relief and renewed investment in agriculture.

Concerns have not diminished with the return to lower commodity prices after the highs of 2006-08. In the first half of 2009, there was a high-level meeting on food security in Madrid at which OECD countries met to reassess donor responses, and the OECD and FAO brought experts together in Paris to advance the debate on some of the long-term issues relating to agricultural investment and to address the challenges faced by many poor countries in promoting growth and poverty reduction as their economies transform. While the emphasis by participants differed, it became clear that the remedy for food insecurity needs to combine strategies to both increase investment in agriculture and reduce poverty.

The first G-8 Farming Summit was held in April, where Ministers of Agriculture of the G-8 countries confirmed that agriculture and food security are at the core of the international agenda, while calling for enhanced investment to improve agricultural productivity and expand production as a way to combat world hunger. The G-8 Ministers' Declaration to world leaders also made reference to the need to reduce poverty, to help farmers manage risk and to sustain the benefits of globalisation and open markets.¹⁸ An UN-backed proposal for another world summit on food security in late 2009 is gaining support. The FAO has a major programme of work underway on feeding the world in 2050 which is looking at available resources, technological challenges, investment needs and policy approaches.

An underlying concern in much of this dialogue on food security is whether the industry will be capable of meeting the growing demand for food associated with a projected world population of 9 billion by 2050. Recent analysis¹⁹ shows that food availability in developing countries will need to increase almost 60% by 2030 and to double by 2050, equivalent to a 42% and 70% growth in global food production, respectively. Will rising food prices drive more of the world's population into poverty and hunger? Can the industry produce almost 50% more food by 2030 and double production by 2050? How much spare

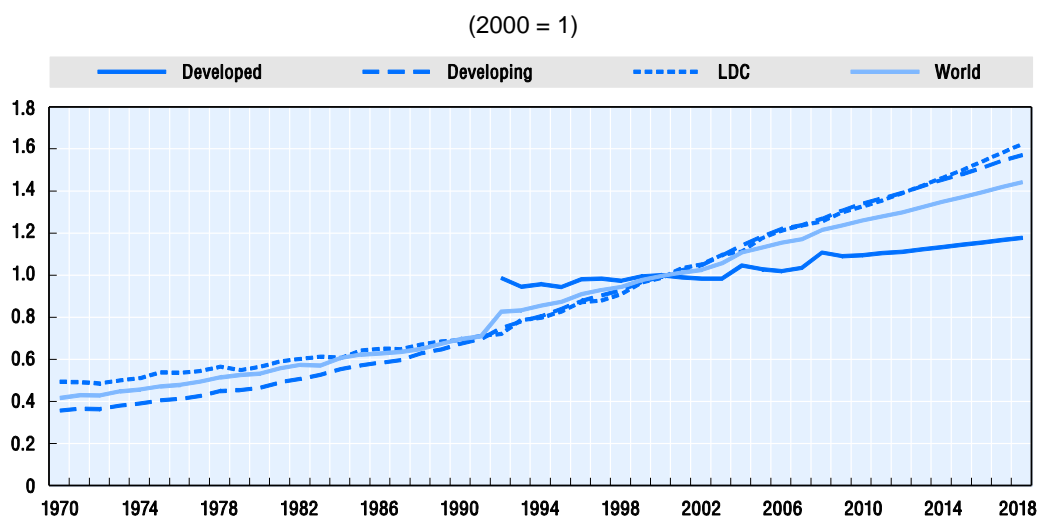
¹⁸ Final Declaration of the G8 Agriculture Ministers meeting, 18-20 April, Cison di Valmarino, Italy: <http://www.g8agricultureministersmeeting.mipaaf.com/it/>

¹⁹ FAO (2006): *World Agriculture: Towards 2030/2050 - Interim report*. Rome; and Bruinsma, J. (2009, forthcoming): *The resource outlook to 2050 - By how much do land, water use and crop yields need to increase by 2050?* Paper to the FAO Expert Meeting on "How to Feed the World in 2050", Rome, 22-24 June 2009. Growth rates are based on 2005/07 average historical data.

capacity is there in terms of land and water? Will new technologies enable us to use scarce resources more efficiently and increase productivity? How will climate change affect various regions in the world?

The FAO has constructed an agricultural production index that shows a sharp rise in world agricultural output over the last 40 years in developing and Less Developed Countries (LDCs) (Figure 3.1). The rate of growth has been impressive, although calculating this production index on *per capita* basis would show smaller gains for the LDCs. A key assumption in the *OECD-FAO Agricultural Outlook* is that this rising production trend will continue over the medium term, reflecting the potential for further gains in productivity. For developed countries, increased production is also assumed, although at a slower rate given the already relatively high levels of productivity. If these assumptions are wrong and production does not rise as expected, the impact on commodity and food prices could be dramatic. A number of studies claim yield growth has been slowing down, leaving a general impression that new technology is not being generated as quickly as it once was.

Figure 3.1. Agricultural production index by region



Rising food prices and the implications for food security was a central focus of last year's *Outlook* report. It recognised that immediate humanitarian aid was required but that longer term solutions depended primarily on fostering growth and development in poor countries to improve incomes and purchasing power. On the supply side, the report called for a closer examination of the potential for, and constraints to, increasing agricultural productivity and output, such as technological innovation and climate change. This chapter responds to that challenge by taking a closer look at some of these longer term supply side issues, specifically the available evidence on the amount of land available for agriculture, prospects for agricultural productivity growth and the increasing competition for water resources.

There is more arable land available...

Gross land balances (GLB) are defined as the total land that is potentially suitable for growing crops but which is not currently being cultivated. GLB estimates have been made using agro-ecological modelling (Fischer *et al* 2002)²¹, taking into account existing soil, climate and terrain conditions in relation to major crop requirements, under various assumptions of land management. These estimates indicate that on a global basis, the total availability of land, which has from moderate to very high suitability for rain fed crop production, is about 43 million square kms, (or 4.3 billion hectares). Currently cultivated world arable land is estimated at about 1.4 billion hectares. Over half of the additionally available land is found in Africa and in Latin America. Furthermore, with estimates of 2.435 and 2.084 million km², respectively, these regions account for most of the land that has the highest suitability class for rain-fed crop production.

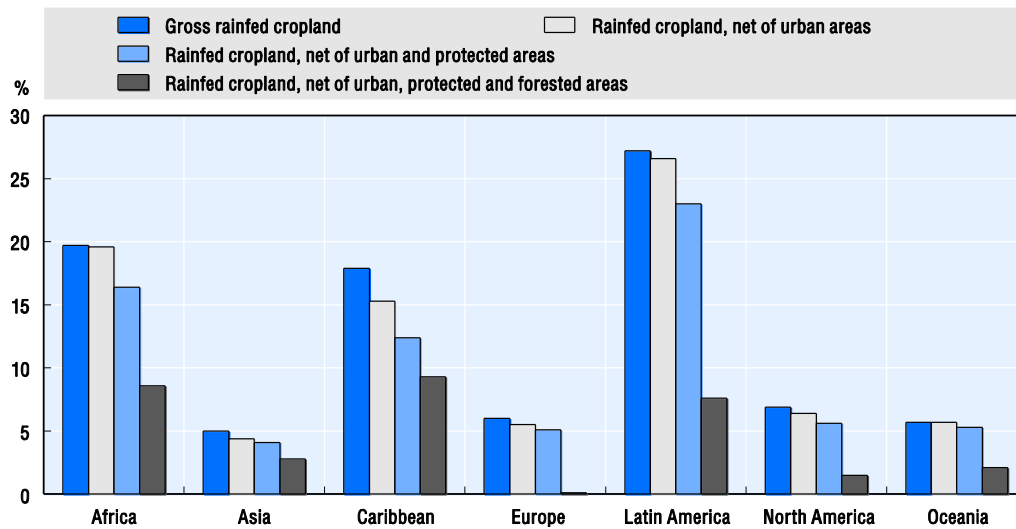
These figures of suitable land are gross 'optimistic' estimates, since they do not take into account the fact that while certain areas of land may be suitable for cropping; they have already been allocated to other competing and socially-acceptable land uses (*e.g.* forests, urban areas, protected areas). Suitable land resources in these latter areas are thus effectively unavailable for conversion to cropland, except at high social/environmental costs of conversion. For many purposes, it is therefore be more realistic, to consider net estimates of the availability of suitable land.

The net land balance value (NLB) is derived from the GLB by excluding areas which are currently allocated to either forests, urban areas or protected areas. As expected, the gross availability of suitable cropland decreases when other competing land-use categories are taken into account. For 54 out of the 148 countries for which data are available, competing land uses reduce the gross land balance by more than 10%. The highest percentage decreases occurring when forested areas are excluded, notably in Latin America, Africa and the Caribbean (Figure 3.2).

²⁰ The background material for this section was contributed by H. George and F. Nachtergaele of the Natural Resources Management and Environment Department at FAO, and Cheng Fang and Merritt Cluff from the Trade and Markets Division. Some of the work reported here was extracted from an unpublished draft report prepared in 2006 on State of Land & Water Resources (SoLAW) by the FAO Land and Water Division.

²¹ One major drawback requiring further research is the effect of land degradation on the quality of the land, which is not taken into account in the agro-ecological approach of Fischer *et al* (2002).

Figure 3.2. Gross and net arable land balances by region, 2002



Note: FAO estimates. Gross and net arable land available by region as a percent of total land area of the region that is potentially suitable for growing crops but which is not currently being cultivated. The net values shown *progressively and cumulatively* take into account non-cropland land uses (*viz.* urban, protected areas and forests) of suitable land.

The competing land use which contributes the most frequently to reducing notably the availability of suitable cropland is forestry. However, the loss of suitable land to urban uses is also important. These numbers suggest that at the world level, some 1 560 million hectares are effectively available for crop expansion. Most of this available land available resides in Africa and Latin America, with the smallest shares in North America and Europe. While there are significant quantities of land available for expansion, it does not reside in the currently high output zones of temperate world agriculture. Indeed, further expansion in both North America and Europe appears limited in relative terms.

The estimates of NLB do not include another possible source of competition, which is that for growing livestock numbers. Livestock populations are growing and with higher incomes, and particularly in populous countries such as India and China, meat consumption will increase in the future. Therefore, pasture land will remain in high demand and may further limit crop expansion. Furthermore, the boom in bio-fuel demand risks to further limit the amount of cropland available for food production, as feedstocks are provided to biofuel production.

The emergence of carbon markets will also affect land availability because some of the options (biofuels and sequestration) compete for the same land resources. The resulting increased competition for land could increase land prices and may also shift production towards commodities with smaller carbon footprints. Growing pressure to address climate change has created rapidly growing carbon markets that are expected to reach billions of dollars in annual transactions within the next 10 years (Box 3.1). Carbon market transactions have been doubling in volume every year with trading worth several hundred million US dollars a year.

... but historical expansion of arable land has been slow

Arable land refers to land under temporary crops (double-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). Abandoned land resulting from shifting cultivation is not included (FAOSTAT). Expansion of land in agricultural use has taken place in countries with growing needs for food and employment, with limited access to technology packages that could increase intensification of

cultivation. Arable land in the world as a whole expanded slowly since 1961-63 (Figure 3.3). For 2006/07, world arable land was estimated at 1.42 billion ha, 135.6 million ha (or 10.5%) above that of 1961-63, growing slowly at an average annual growth rate of 0.2%.

Box 3.1. Agriculture, climate change and carbon markets

Carbon emission markets establish a market-based instrument for trading carbon credits. Carbon trading is seen to be an effective mechanism to curb emissions of greenhouse gases (GHG), while minimizing impacts on economic growth by providing flexibility in meeting emissions regulations. A key driver of carbon markets is the Kyoto Protocol, under which 38 industrialized countries agreed to cut their emissions of greenhouse gasses from 5-8% below 1990 levels between 2008-12.

The two main policy options that have gained most interest are carbon taxes and carbon emissions trading systems. In addition to emission reductions, the Protocol approves offsets through enhancement of sinks which absorb greenhouse gases. In the Protocol, agriculture is both an *emitter* of and a *sink* for greenhouse gases. In 2005, agriculture contributed about 10-12% of greenhouse gas emissions (GHGs). Agriculture accounts for about 50% of global methane and about 60% of global N₂O emissions (IPCC 2007). The share of agriculture in total emissions of different gases varies considerably between countries.

There are at least four ways agriculture may participate in or be influenced by GHG mitigation efforts: reduction of emissions from agricultural production; enhancement of greenhouse gas absorption by creating or expanding sinks; provision of products which substitute for emission intensive products, such as biomass for bioenergy to replace fossil fuels; and through greenhouse gas mitigation policies on agricultural input and output prices (McCarl and Schneider, 2000).

GHG emissions mitigation options in the livestock sector include: reduction of soil carbon losses through improved grassland and pasture management; reduction of methane emissions of livestock through better diets and genetics, and better manure management; and reduction of nitrous oxide emissions through altered diet and improved manure storage and applications methods.

Withdrawing carbon from the atmosphere and storing it in agricultural and forest soils and biomass has the potential to sequester large amounts of carbon. For cropland the main options with the highest potential for storing carbon are afforestation, conversion of cropland to perennial grasses, and switching from conventional tillage (moldboard plough tillage) to reduced tillage or no-till. Options with lower carbon-storing potential include changing crop rotations, elimination of summer fallow, expanding the use of winter cover crops, and improved management of fertilizer, manure and irrigation (Antle 2009, Lewandrowski *et al.* 2004).

Establishing comparability between carbon emission reductions and carbon sequestration requires consideration of the temporary greenhouse mitigation effect of carbon sequestration relative to emission reduction (permanence) and the finite period of time that soil can accumulate additional carbon (soil carbon stock equilibrium). An additional policy issue is whether farmers are paid for carbon sequestered (gross sequestration) or whether they are paid for carbon sequestered and charged for carbon emitted (net sequestration). Given a carbon price of USD 125 per tonne of carbon permanently sequestered, a payment for gross sequestration would reduce emissions by 3.5 MMT at a cost of USD 1.5 billion while a payment for net sequestration would reduce emissions by 7 MMT at a cost of USD 300 million - twice as much carbon at one-tenth the average cost per tonne (Lewandrowski *et al.*, 2004).

Many of the carbon sequestration activities or mechanisms have ancillary benefits and costs which need to be taken into account when designing carbon sequestration policies. For example, reduced tillage usually reduces soil erosion and nutrient runoff, but it may increase the use of herbicides for controlling perennial weeds and thus may ultimately increase herbicide runoff. Conversion of crop land to perennial grasses may improve wildlife habitats and increase species diversity. On the other hand policy measures that are designed for addressing water quality, such as establishment of green set-asides and buffer strips can contribute to carbon sequestration.

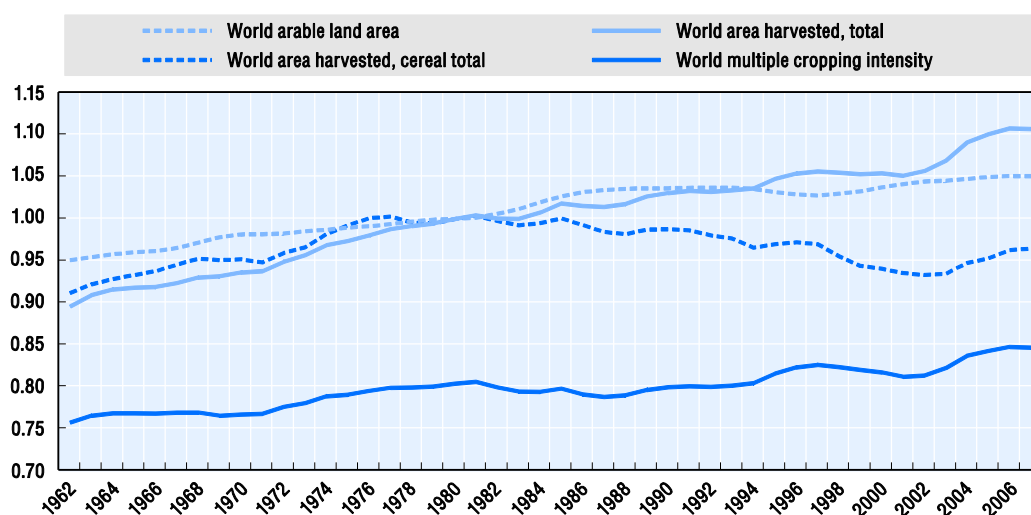
The expansion of global arable land has mainly occurred in Asia, Africa, and America (Figure 3.4). Between 1961-63 to 2006-07, arable area increased from 154.5 million ha to 213.1 million ha in Africa (an increase of 58.6 million ha or 38%), and from 412 million ha to 511.5 million ha in Asia. In America, with the exception of North America, arable land also increased, but most of the increase was before 1990. In Brazil alone, arable land increased by 35 million ha (or 145%) during the same period. In general, the countries with low income and a food deficit had a greater expansion of arable land, driven by strong domestic demand for agricultural products. For the group of Net Food Import and Developing Countries

(NFIDC), arable land increased by 55 million ha or by 34%. For the landlocked developing countries, the arable land expanded by 73 million ha or by 160%. The net increase of arable land is a total of gross land expansion minus land taken out of production for various reasons, such as degradation or loss of economic viability. Deforestation has been a major factor linked to the arable land expansion in many developing countries.

An opposite tendency has been observed in a number of the Newly Independent States over the last 20 years, where economic transformation led to a significant fall in area used for agricultural production. For example, between 1990 and 2007 total area sown to crops declined from 117.7 million to 76.4 million hectares in Russia and from 32.4 million to 26.1 million hectares in Ukraine (OECD 2009a)

In contrast, the developed world has experienced the contraction in arable land: in Europe, arable land declined by 0.9% annually between 1961/63 and 2006/07. In Northern America the decline was 2% annually. The longer-term forces determining such declines are sustained yield growth, and farm consolidation combined with a continuing urban expansion, and also affected by phenomena such as policy changes in the industrial countries and political and economic transition issues in the former centrally planned countries.

Figure 3.3. World trend of arable, harvested land areas, and multiple cropping intensity (1980=1)



Source: Based on FAOSTAT data.

Cropping intensity has increased...

Multiple cropping is the practice of growing more than one crop on the same land during one year. It involves several alternative patterns of crop management in space and time such as mixed cropping, intercropping, relay-cropping, sequential cropping, double cropping, triple cropping, etc. (FAOSTAT). In this analysis, the multiple cropping index (MCI) is calculated as the sum of area harvested for different crops during the year, divided by the total arable land.²²

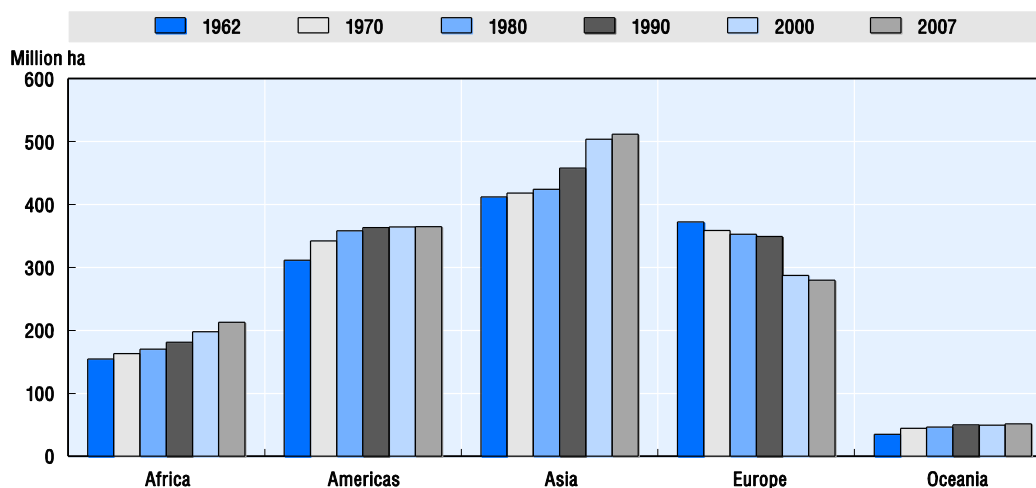
Cropping intensities continue to rise with more multiple cropping and shorter fallow periods. An increasing share of irrigated land in total agricultural land is the major factor for the more multiple cropping. The overall cropping intensity in the world has risen steadily over the period 1961-63 to 2006-07

²² Total area and not cultivated area, as often no data are available.

(Figure 3.3). The highest growth is observed in Africa and Oceania (an increase by 25 percentage points and 16 percentage points, respectively), while there is a significant reduction in Europe (a decrease by 8 percentage points).

Although the arable area expanded by 135.6 million ha between 1961/63 and 2006/07, harvested area expanded by 229.5 million ha (or 23.6%) because of increases in cropping intensities. Of the increase in area harvested, about half is attributable to the expansion of arable land, and half to the increase of MCI.

Figure 3.4. Arable land by region



Source: Based on FAOSTAT data.

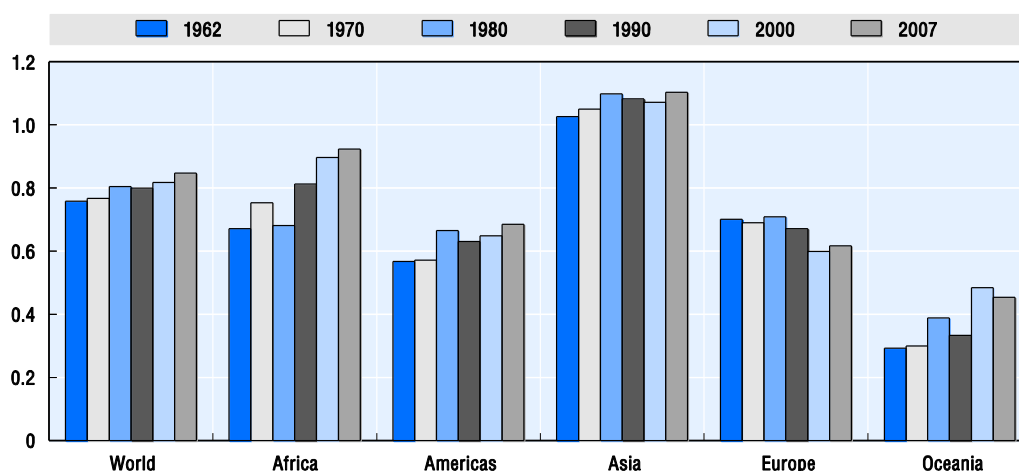
... but there are large regional differences and the pace is slowing

The highest MCI are in Asia and lowest in Oceania, as shown in Figure 3.5. In South and East Asia, about one-third of the arable land is irrigated, which is one of the reasons why the average cropping intensities in Asia are considerable higher than in the other regions. While MCI has increased in all regions, except Europe, there is a significant difference in among regions. The highest growth is observed in Africa and Oceania.

Over this same period, harvested area increased 127% (13 million ha) in Oceania and 90% (93 million ha) in Africa. In both cases, about half the increase was from the arable land expansion and half from the increase in MCI. Among sub-regions of Africa, Western Africa accounts for the largest increase (by 52 million ha or 137%). In Asia, harvested area expanded by 141.7 million ha or 33.6% during this period, with about three-quarters of the increase due to arable land expansion and one-quarter to the increase of cropping intensity. Contrary to other regions, Europe had a reduction of 88 million ha or 34%, mostly as a result of the arable land area reduction.

The trends of MCI and harvested area in general are expected to continue, but at a slower pace. As industrialisation and urbanisation continue in many developing countries, more cropland will be used for industrial and residential developments. Rapid industrialisation will also continue to pull labour out of the countryside and agriculture, and lead to less double cropping. Moreover, ever more intensive use of land in production in some regions through multiple cropping is perceived as a leading factor for land degradation and the undermining of its long-term productive potential (FAO 2003). However, a potential for big increase in MCI and harvested area exists in some regions, such as Latin America and some African countries.

Figure 3.5. Multiple cropping index in selected years



Note: MCI is calculated as the sum of area harvested divided by total arable land (not total cultivated area).

Source: Calculated based on FAOSTAT data.

Technology and productivity²³

In developed countries, there have been a wide range of technical advances for agriculture - genetic improvement, chemical fertilizers and pesticides, farm equipment and machinery, and cultural and management practices. Research in both the public and private sectors has been the primary source of new technologies, with the private sector becoming increasingly involved in new technology development and marketing and being the exclusive source of GM (genetically modified) crops in OECD countries. Technologies available to farmers are continuously changing. However, agricultural productivity, which is a reflection of the adoption and diffusion of successful technologies, has slowed over 2000-06 relative to the 1990s in the EU, North America, in high income Oceania and in large developing or transition economies. Among developed countries, an exception to this pattern is Northeast Asia developed countries, such as Japan and Korea, which experienced higher agricultural total factor productivity (TFP) growth in the latter period.

For developing countries as a whole, there is some evidence that crop yield growth has actually accelerated. One recent study on developing countries found crop yield increases for the 1980-2000 period were higher than for 1961-80 for cereals (total), lentils, millet, potatoes, paddy rice, and wheat, while lower for barley, cassava, sorghum and, to a lesser extent, maize (Evenson and Gollin, 2003). The study concluded that the Green Revolution effects on crop yields in developing countries were not confined to the period 1960-80. In fact, yields of many key crops in developing countries actually increased faster over the 1980-2000 period.

In the context of examining the industry's prospects for a significant future supply response, it is yields that are of significant importance and the primary focus of this section. For major crops, evidence of what is happening to yields in frontier production regions is presented. For livestock, the best available evidence is a more global comparison of total factor productivity developments.

²³

Major contributions to this section were provided by W. Huffman, Iowa State University, Department of Economics; J. Piesse of King's College London and University of Stellenbosch, Republic of South Africa; C. Thirtle, Imperial College London and University of Pretoria, Republic of South Africa.

Crop yields continue to increase...

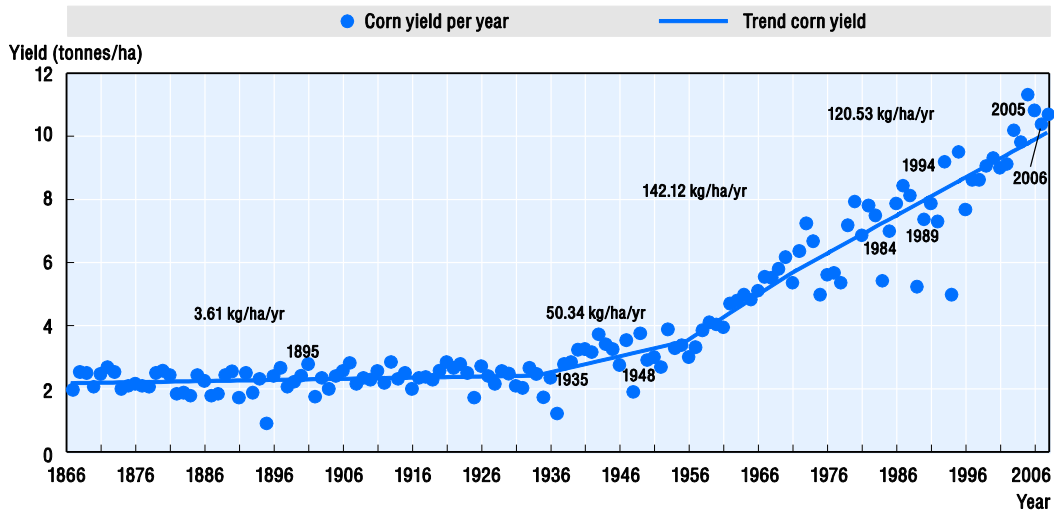
Within the OECD area, the leading production region for corn and oilseeds is the US Midwest, for example, in the state of Iowa, which has rich soils, relatively abundant summer rainfall, temperate growing season, and access to the most advanced corn and soybean varieties. Wheat is the main cereal crop of the EU, and France is the leading producer under abundant resources. In contrast, wheat is produced in the US Great Plains and Prairie Provinces of Canada under limited resources, especially water, which also limits other inputs, such as fertilizer. The state of Kansas is the leading US producer of wheat. Japan is a high technology producer of paddy rice, which is irrigated or flooded and well fertilized. The Netherlands is on the frontier of potato production with abundant water, fertilizer and good pest control.

The (trend) rate of crop yield improvement in the three main cereal crops of corn, wheat and rice; leading oil crop-soybeans; and the leading vegetable crop for providing energy (potato) in major producing regions of the OECD is roughly unchanged over the past half century. The rate is highest for Dutch potatoes, Iowa corn and French wheat at 324, 120, and 105 kg per hectare per year, respectively, and significantly lower for Kansas wheat, Japanese rice and Iowa soybeans of roughly 25 to 32 kg per hectare per year.²⁴ Corn yields in Iowa, however, may be entering a new era, as of 2004, where yields are increasing at a significantly faster rate than 120 kg per hectare per year.

Corn is an important animal feed and food staple, an excellent source of carbohydrates but low in protein. The most important advance in the cultivation of corn was the introduction of hybrids in the early 1930s. Figure 3.6 plots actual corn yields in kilograms per hectare from 1866 to 2007. Since 1970, the trend rate of increase in Iowa average corn yields has been 119 kg per hectare per year, with the state average yield exceeding 10 tonnes per hectare in 2007. However, the state average yields in 2004-07 were somewhat above the trend line, suggesting that a new era of even higher increases in the trend for Iowa average corn yields. This may be due to the new corn varieties adopted by farmers that contain stacked GM traits. For example, 2004 was the first year in which one-half of Iowa's corn acreage was planted to corn varieties containing two or more stacked GM traits, and in 2007, varieties with triple stacked GM traits were widely planted by Iowa farmers, with these hybrids containing Bt for corn borer resistance, IP for corn rootworm and tolerance to the herbicide glyphosate. In particular, the rootworm resistance provided impressive improvement in plant root structures and plant standability under rootworm infested field conditions.

²⁴ Standard weights: 45 pounds of rough rice per bushel; 56 pounds of shelled corn per bushel, and 60 pounds of wheat, soybeans, and potatoes per bushel. Also, one pound per acre equals 1.121 kilograms per hectare.

Figure 3.6. Average Iowa corn yields

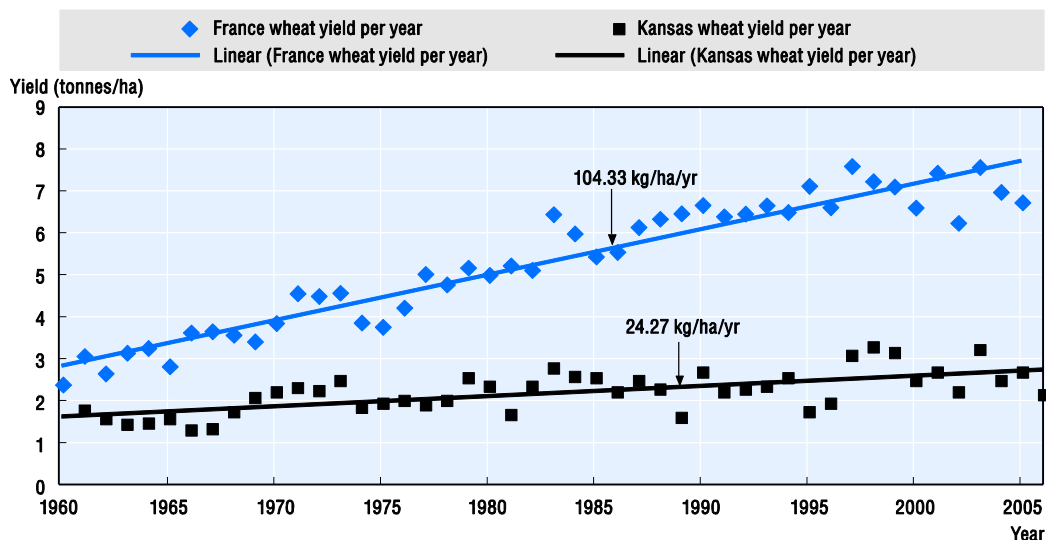


Source: Huffman (2009).

Wheat production is widespread throughout the world and supplies much of the world's dietary protein and food supply. The rate of increase in Kansas wheat yields over the 1950-2007 period was 24.27 kilograms per hectare per year, with average yield in 2007 at 2.15 tonnes per hectare (Figure 3.7). Much of this increase was due to the development of new wheat varieties. Wheat yields in France averaged 2.3 tonnes per hectare in 1960 and have a strong linear trend upward over 1961-2007 at 104 kilograms per hectare per year. The predicted wheat yield based on the linear trend is 7.6 tonnes per hectare in 2007 but this was 15% above actual average yield. An as yet unpublished study by INRA argues that the reductions in wheat yield growth in France since the early 1990s was due to climate change.²⁵ While yield increases may have slowed in recent years, French wheat yields have improved much faster than in Kansas, a reflection of the use of lower quality land for wheat production in Kansas.

²⁵ Gilles Charmet, INRA, *Les causes du plafonnement du rendement en grandes cultures*, presentation to the 2009 Salon International de l'Agriculture.

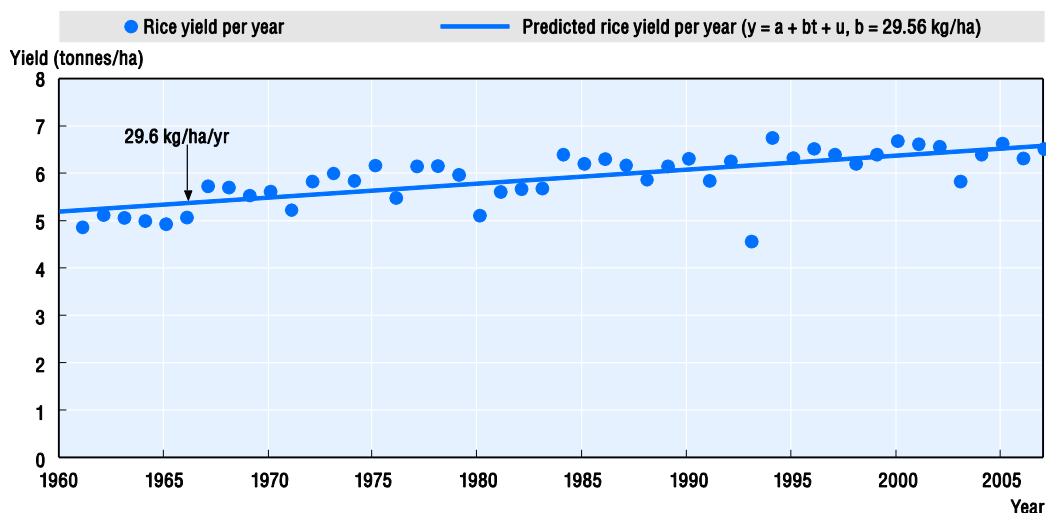
Figure 3.7. Average wheat yields, Kansas and France



Source: Huffman (2009).

Rice is the world's most consumed cereal after wheat, providing more than 50% of the daily calories ingested by more than half of the world population. Japanese country-wide average rice yields were 4.8 tonnes per hectare in 1960 and increased to 6.5 tonnes per hectare in 2007 (Figure 3.8). The trend rate of increase in average yields is 29.6 kg per hectare per year. Paddy rice in Japan is intensive agriculture on good quality land and the average rate of yield increase compares favourably to dry land low-resource input wheat in Kansas. However, it lags behind wheat yield gains in France and dry land, resource abundant corn yields in Iowa.

Figure 3.8. Japan rice yields

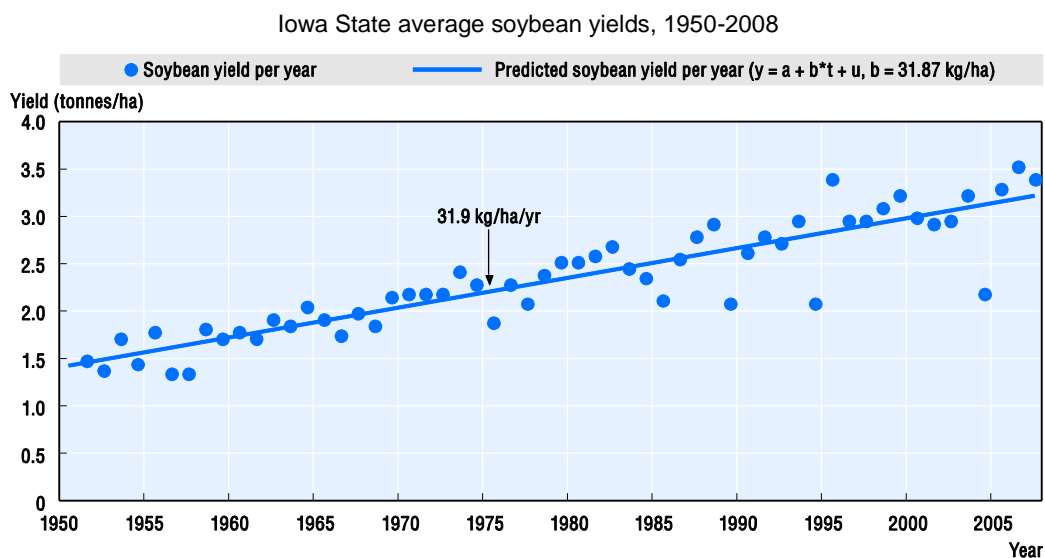


Source: Huffman (2009).

Soybean production is the leading source of vegetable oil in North and South America and China. Figure 3.9 shows Iowa average soybean yield trends over a 60-year period. The average trend rate of

increase is 31.9 kg per hectare per year. In contrast to hybrid corn, the development of new soybean varieties for the US Corn Belt has been primarily by the public sector up to the mid-1970s (Huffman 1987). In 1970, the US passed a Plant Variety Protect Act providing better intellectual property protection to new soybean varieties and private sector on soybean varieties have gradually replaced public sector varieties. Currently, virtually of the planted soybean varieties in Iowa are developed and marketed by private seed companies. Starting in 1996, varieties containing GM herbicide tolerance (HT) became available to Midwestern farmers. The same linear yield trend is observed for the 1996-2008 period when HT soybean varieties were being rapidly adopted by farmers.

Figure 3.9. Iowa soybean yields

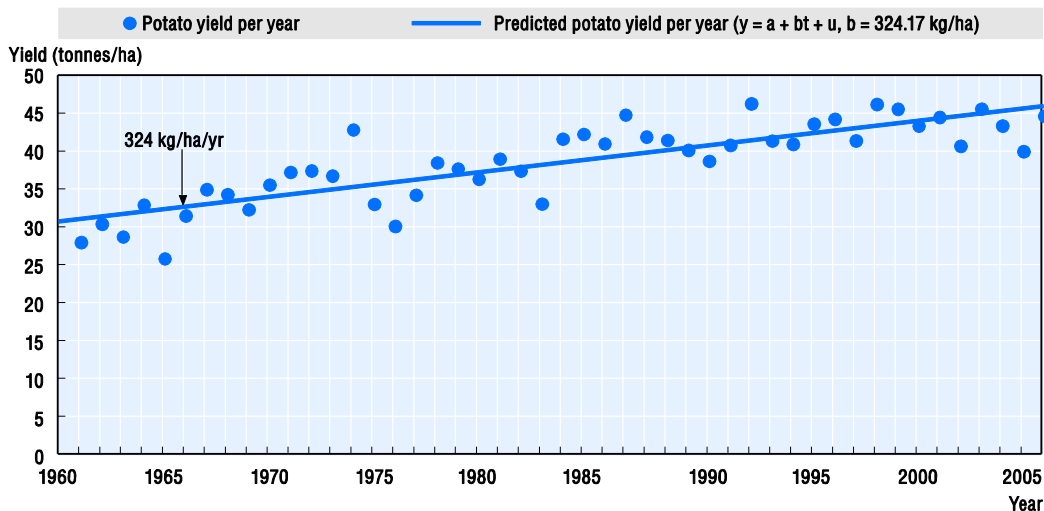


Source: Huffman (2009).

2008 was the international year of the potato. It is the world’s number one non-grain food commodity, with consumption expanding rapidly in developing countries, which now account for more than half of the global harvest. Figure 3.10 plots Dutch potato yields from 1961. For over more than a half century, the trend has been constant at 324 kg per hectare per year. The average potato yield in 2007 was about 44.7 tonnes per hectare. These comparisons show that trend yield increase in Dutch potatoes is large relative to the yield increases in other major food crop sources of calories such as corn in the US Corn Belt, wheat in France or rice in Japan.²⁶

²⁶ One notable difference between potato and corn grain is the water content. Number 2 yellow corn is standardized to 14% moisture content. In contrast, potatoes are 72-75 % water (FAO 2009).

Figure 3.10. Dutch potato yields



Note: Ware, starch and seed potatoes.

Source: Huffman (2009).

... and livestock productivity growth has accelerated

Technical advances in livestock production are a result of genetic improvement of animals, improved disease control, improved structures and improved management practices. Steady improvements in animal genetics have occurred with the use of artificial insemination, which is now widespread and pervasive in modern dairy, swine and poultry production. Cross-breeding was a new technique in swine production in the 1950-60s, but it has since spread to beef herds as a means to improve genetics for rapid growth and quality attributes of meat. Livestock production in the US, Spain, the Netherlands, Denmark, Belgium and Germany have become specialized into large units for broilers and layers and also cattle finishing in the US, which reduces labour intensity.

The largest dairy herds in OECD countries are in the US West and South - Florida, Arizona and California where herd sizes are 5 000-10 000 cows. Extremely large dairy herds have not been adopted in the US Upper Midwest and New York or in Europe where herd sizes are typically still 100-200 cows. Switzerland and Norway have even smaller average dairy cow herd sizes. Totally automated dairy cow feeding and milking exists in some advanced European countries, but not in the US where relatively cheap immigrant farm workers have been integrated into factory-type specialized livestock operations.

A recent publication, *Handbook of Agricultural Economics, 2007*, provides a global comparison of livestock productivity of 115 regions (92 developing and 23 high income regions) over two periods - 1961-80 and 1981-99. The later period showed higher total factor productivity (TFP) growth with Asia showing the fastest expansion followed by Latin America, with Sub-Saharan Africa remaining relatively stagnated over the period (Table 3.1). Acceleration of TFP growth in the latter period was mainly the result of an increased rate of expansion of the technical frontier.

Table 3.1. Livestock total factor productivity growth

	1961–1980			1981–1999		
	Total factor productivity	Technical change	Efficiency	Total factor productivity	Technical change	Efficiency
South Africa	-0.73	0.67	-1.39	1.3	0.74	0.56
Sub-Saharan Africa	0.01	0.01	0	0.02	0.03	0
Africa	0.17	0.31	-0.14	0.63	0.21	0.43
China	0.32	1.04	-0.72	6.27	0.82	5.4
India	-1.05	0.64	-1.67	1.66	1.62	0.05
Asia	-0.75	1.11	-1.85	2.54	2.33	0.21
Mexico	0.39	0.77	-0.38	1.41	0.64	0.76
Brazil	-2.38	1.1	-3.44	1.73	1.07	0.66
Latin America	-0.44	1.01	-1.43	1.15	1.55	-0.39

Source: Alejandro Nin, Simeon Ehui and Samuel Benin (2007) using FAO (2003) data.

The report also estimated average productivity growth gains over the 1961-2001 period for ruminants (beef and dairy) and non-ruminants (pigs and poultry) within the livestock sector. For developed, developing and Least Developed Countries (LDCs), productivity growth gains were much higher for non-ruminants (Table 3.2). For non-ruminants, productivity gains in developing countries slightly outpaced developed countries, while for ruminants developed countries showed much higher average gains. LDCs lagged well behind in non-ruminant livestock productivity gains but matched the gains of developing countries for ruminants.

Table 3.2. Annual total factor productivity growth rates for livestock, 1961-2001

Region	Total Livestock	Ruminants	Non-ruminants
Developed countries	1.04	0.93	2.11
Developing countries	0.57	0.38	2.38
Least developed countries	0.54	0.4	1.24

Source: Ludena *et al.* (2005).

The contribution of technical change and efficiency to TFP growth varies across regions and species. Biological and natural resource differences lead to different production processes. TFP growth is driven by land productivity and changes in output per head of animal stock in countries with high labour/land ratios like China and India, while in countries with low labour/land ratios like Brazil, for example, increases in livestock productivity have come from increases in labour productivity.

Expenditures on research and development continue to rise...

The 1950s and 1960s saw science increasingly applied to agriculture in developed countries with rapidly rising productivity growth, whether measured by yields, labour productivity or TFP. New crop varieties were being developed that could be fairly quickly adapted by developing countries. The 1960s and 1970s saw this process extended to developing countries as the green revolution raised yields, especially in the densely populated countries of Asia.

The international transmission of productivity enhancing technologies depends on the rate at which new technology becomes available, the extent to which it is allowed and encouraged to spill over into other jurisdictions and the capacity of the recipient countries to identify, customise and diffuse what is available.

For many developing countries, infrastructure and institutional weaknesses are more of a constraint to increasing productivity than the level of research expenditure. To capitalize on the potential to improve productivity growth in developing countries requires development, adaptation and adoption of appropriate technologies. There is technology “on the shelf” for developing countries to adapt and those with good institutional capability can prosper under these circumstances. South Africa is a case in point. Following the establishment of majority rule, there were over 4 000 employees in the Agricultural Research Council. Studies showed that the South African research system concentrated on adaptive R&D and had consistently high rates of return (Thirtle *et al.*, 1998; Townsend and Thirtle, 2001).

Public investment in agricultural research continues to rise in real terms but growth rates in public agricultural research expenditures declined in the 1980s, and continued to fall in the 1990s (Beintema and Stads, 2008). The average expenditure growth rate for 32 high income countries was .52% for the 1990-2000 period, down from 2.43% the previous decade (Table 3.3). For Sub-Saharan Africa as a whole, the growth rate was actually negative in the 1990s, and in about half of the 24 countries in the region for which time-series data is available. The growth rate in public agricultural research expenditures declined but remained positive for Asia and Pacific, Latin America and the Caribbean and West Asia and North Africa. These regional trends hide a growing divide between the scientific haves and have-nots. In the Asia-Pacific region, just two countries, China and India, accounted for 89% of the increase in regional spending from 1995 to 2000, and 67% of the regions total expenditure in 2000. In high income countries, public agricultural research expenditures increased as a share of AgGDP to 2.35% over the 1980-2000 period, while it has remained relatively flat (and much lower) in low and middle income countries (Table 3.4). The private sector has become an increasingly important contributor to research and development in agriculture.

Table 3.3. Growth rates in public agricultural research expenditures

Country group	1976-81	1981-91	1991-2000
Low & middle income :		(percentage)	
Sub-Saharan Africa (45)	0.94	1.02	-0.15
Asia-Pacific (26)	7.98	4.67	3.35
Latin America & the Caribbean (25)	8.54	1.86	0.32
West Asia & North Africa (12)	na	4.12	2.93
Subtotal (108)	6.36	3.02	1.91
High income (32)	2.5	2.43	0.52
Global total (140)	na	2.66	1.1

Note: n.a - not available.

Source: Beintema, N. M and Stads G. (2008), calculated by authors based on ASTI datasets, MOST (various years), OECD (various years), and Pardey *et al.* (2006); 1976-81 growth rates are from Pardey and Beintema (2001).

Table 3.4. Public agricultural research expenditures as a share of AgGDP

Country group	Agricultural R&D spending as a share of AgGDP		
	1981	1991	2000
Low & middle income :	(percentage)		
Sub-Saharan Africa (45)	0.86	0.76	0.65
Asia-Pacific (26)	0.33	0.37	0.39
Latin America & the Caribbean (25)	0.91	1.08	1.19
West Asia & North Africa (12)	0.6	0.6	0.74
Subtotal (108)	0.56	0.56	0.55
High income (32)	1.51	2.08	2.35
Global total (140)	0.91	1	0.98

Source: Beintema, N. M and Stads G. (2008), calculated by the authors based on ASTI datasets, MOST (various years), OECD (various years), and Pardey *et al.* (2006); GDP deflators are from World Bank (2008c).

... with private sector research and development a major driving force

The private seed industry has set as a goal doubling corn, soybean and cotton yields in the US by 2030. Average corn yield increases would need to be three times the trend growth over the 1970 to 2007 period, or about 6 bushels per acre per year. This is clearly an ambitious goal. They have successfully tested drought tolerant corn varieties for the US Western Great Plains. The drought tolerance is to boost yields by 7-10% in a one-year drought. However, this technology for drought tolerance enables the corn plant to withdraw a larger share of the moisture in the subsoil and to avoid shutting down physiological processes under water and heat stress. However, if the drought lasts for multiple years, these varieties are unlikely to have advantages beyond the first year. For many areas faced with extended periods of drought - Australia, the US Great Plains, Africa, the current technology may have limited application. New third generation corn varieties developed for the US which have insect tolerance for three below ground pests, have great potential for improving root structures and root volume of the corn plants, which indirectly improves drought tolerance, but also improves nutrient uptake and standability against strong wind and rain, which makes harvesting easier.

Over the next decade, private sector developed and marketed GM technology for wheat and rice varieties remains uncertain. Monsanto, for example, is planning to re-enter the market with new wheat varieties over the next decade. Wheat production in the US and Canada is largely low-resource input agriculture, and new varieties have been developed primarily by public sector research. Over the next decade the trend rate of yield increases, which are modest, are expected. In Australia, researchers there are attempting to develop perennial wheat varieties, including salt tolerant ones that will over time yield significantly more grain than annual wheat varieties. There is also an attempt to introduce new perennial plants, *e.g.*, chicory, wild relatives of lucerne, cocksfoot, and birdsfoot trefoil, as a pasture crop for cattle and sheep. The goal is to increase the carrying capacity of grazing lands.

Research is also underway that will increase soybean yields. Soybean germplasm has been identified that will significantly increase soybean yields in conjunction with second generation herbicide tolerant varieties. The target increase is a 6-10% yield increase compared to elite conventional soybean varieties. Soybean and canola varieties in North American are over 90% GM herbicide tolerant (HT), and other oilseed crops are likely to come under competitive pressure to incorporate GM for HT because of the indistinguishable nature of the oils.

The potential for future benefits from GM potato varieties developed by the private sector are large and likely to be realized by 2019 in OECD countries, Argentina, Brazil, China and perhaps Russia. New GM varieties for late blight and Colorado potato beetle resistance would create valuable biological pest resistance to all sizes of potato farms, including home plots/gardens. Also, new GM traits for product-

enhanced potato varieties will be released for sale to farmers in the near future. They are expected to contain high levels of anti-oxidants and vitamin C and low acrylamide levels.

Water and climate change

Competition for water will increase...

Water scarcity is an increasing threat in many regions, as water pollution and consumptive use reduce available sources, while populations grow and competition between different uses increases. In 2005, 35% of the population of the OECD was living in areas characterized by severe water stress, compared with 44% worldwide (OECD, 2008b). At a global level, some 1.2 billion people live in basins where the physical scarcity of water is absolute (human water use has surpassed sustainable limits) (CA, 2007). By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions, mostly in non-OECD countries.

Water withdrawals are projected to increase at a much higher pace in developing relative to OECD countries, and for non-agricultural compared to agricultural uses. At the same time, global demand for food and non-food agricultural products will continue to increase mainly as a result of the growth in incomes, population and urbanisation. This will chiefly be driven by developing countries, but agricultural production in many of these countries will be much more constrained by pressures on the natural resource base, including land and water, notably in China and India.

Agricultural water withdrawals are dominated by developments in irrigation, as this is assumed to account for 99% of agricultural water withdrawals (the remainder is accounted for by livestock), and, in particular, by China and India as the volumes involved in these countries are so large. Both FAO (2003) and CA (2007) project a substantial slowdown in expansion of area under irrigation compared to past decades. Future gains in irrigated agriculture will come from improved performances of existing irrigation in all irrigated regions of the world, in order to meet the projected global increase in agricultural commodity production.

OECD agricultural exporting countries are expected to be a continuing and expanding source of food and non-food agricultural commodity exports, mainly to Asian, African and Middle Eastern countries. Such an expansion in OECD agricultural production and exports will necessitate improved productivity in agriculture, both in rainfed and irrigated farming systems (see Box 3.2 for developments in agricultural water use in the OECD area).

Box 3.2. Agricultural water resource use in OECD countries

Agriculture accounted for 44% of total water use in 2002-04, although for a number of countries the share is over 60%. Agricultural water use grew by 2% over the period between 1990-92 and 2002-04, mainly driven by an increase in the area irrigated, compared to a 1% increase for all water uses; however, for some countries in more recent years this trend is reversing with agricultural water use diminishing compared to growth in other water-consuming sectors. The area irrigated rose by 8% compared to a reduction of 3% in the total agricultural area between 1990-92 and 2002-04, although in a number of countries the area irrigated has been decreasing. Agriculture abstracts an increasing share of its water supplies from groundwater, and the sector's share in total groundwater utilisation, although data are limited, was above 30% in one-third of OECD countries in 2002.

Some positive developments: Increases in physical water productivity by agriculture, through better management and uptake of more efficient technologies, such as drip irrigation and adoption of water-saving farm practices, has contributed to higher farm production. Overall, the OECD average water application rate per hectare irrigated declined by 9% between 1990-92 and 2002-04, while in most cases the volume of agricultural production increased. The adoption of drip irrigation, low pressure irrigation systems, and other water-saving technologies, are becoming more widespread, while there are also some improvements in flood irrigation systems (e.g. laser levelling of fields, neutron probes for soil moisture measurement, scheduling of irrigation to plant needs, and faster flow regimes) and irrigation canal networks (e.g. replacing earth with concrete linings for irrigation canals). Pollutant discharges from farmland into water bodies have been declining recently in many OECD regions, but information on the trends in pollutants from irrigated land is patchy.

Some negative developments: Groundwater use for irrigation is above recharge rates in some regions, which is also undermining the economic viability of farming in affected areas and leading to harmful environmental impacts, such as reduced flows of connected surface waters. Farming is a major and growing source of groundwater pollution in some countries, mainly from nutrients, pesticides and salinity. This is of concern where groundwater provides a major share of drinking water supplies for both human consumption and farming. Over-exploitation of surface water resources in certain areas is damaging ecosystems by reducing water flows below minimum flow levels in rivers, lakes and wetlands, which is also detrimental to recreational, fishing and cultural uses of these aquatic ecosystems.

Sources: OECD (2009b); OECD, (2009d); OECD (2008a).

... but will agricultural water use still increase or will it decline?

A substantial level of variation can be noted among projections for 2025 (Table 3.5). Projections of global irrigation water withdrawals differ for a number of reasons including, for example: data sources (note the differences in base year global irrigation withdrawals in Table 3.5); definitions (irrigation water use defined as total withdrawals or crop evapotranspiration; underlying model structures and estimates of irrigation water use efficiency, and assumptions made in developing models. This highlights the need to improve the base water use data in projection models and refine model specifications.

According to the Comprehensive Assessment of Water Management in Agriculture (CA, 2007), water withdrawal for irrigation is expected to increase by 13% between 2000 and 2050, with all the increase taking place in developing countries. Preliminary projections prepared in the framework of FAO's *Agriculture - Towards 2030 and 2050* (FAO, forthcoming) confirm these projections, with a global increase in agricultural water withdrawal between 2006 and 2050 estimated to be in the order of 10%. However, OECD (2008a) together with a study by Alcamo (2007), predict a decline in the world's agricultural water withdrawal while other comparable studies project an increase (Table 3.5). What is certain is that projected increases in global production will necessitate further improvements in water efficiency by agriculture to avoid additional stress on scarce water resources in many regions.

Table 3.5. A selection of global projections for irrigation water withdrawals

Source	2000	2025	Change 2000 - 2025
	Cubic kilometres	Cubic kilometres	%
OECD (2008b)	2874	26311	-8
Shen <i>et al</i> (2008)	2658	3388 – 3665 ²	+27 to +38
IWMI (2007)	2630	2800 – 3400 ²	+6 to +29
Alcamo <i>et al</i> (2007)	2498	2341 – 2366 ⁴	-5 to -6
Shiklomanov (2000)	24883	3097	24
Seckler <i>et al</i> (2000)	24693	2915	18
Alcamo <i>et al</i> (2000)	2465 ^{3,4}	2292 – 2559 ²	-7 to +4
IFPRI (2008)	2245	2491 – 2594 ^{1,2}	+11 to +15

Notes:

1. Projection year is 2030 instead of 2025.
2. Projections show data for a range of different scenarios
3. Base year is 1995 instead of 2000 4. Projections include total agricultural water withdrawals (*i.e.* including water for livestock)

Sources: OECD, adapted from CA (2007) and other sources.

... and what will be the effect of climate change?

The direction of future policies to address the management of water resources in agriculture are projected to be greatly influenced by climate change and climate variability. A survey of OECD countries reveals the incidence and severity of flood and droughts has been increasing for the majority of countries, although there is significant regional variation within and across OECD countries (OECD, forthcoming (b)). Many of these countries also project that with climate change the incidence and severity of flood and drought events may continue to increase. Climate change is expected to affect the function and operation of existing water infrastructure (*e.g.* irrigation systems) as well as water management. Moreover, current water management practices may not be robust enough to cope with the impacts of climate change on, for example, water supply reliability, flood risk, agriculture and ecosystems. The Intergovernmental Panel on Climate Change (IPCC) report on climate change and water (Bates *et al* 2008), concludes that “observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies”. Climate change’s main water-related impacts with regard to agriculture are expected to be felt in terms of shifting and more variable hydrological regimes. Specifically concerning agriculture, the IPCC projects that changes in water quantity and quality due to climate change are expected to affect food availability, stability, access and utilisation (Table 3.6).

Climate change is expected to have a dual effect on irrigated agriculture. First, higher evaporative demand as a function of overall temperature increases will translate into higher levels and intensities of water withdrawals. Second the anticipated increase in volatility of rainfed production will put pressure on irrigated areas to buffer the global production risk, The demand for more reliable agricultural production systems at local and regional level is expected to increase and trends toward more precision agriculture with more secure supply chains are already evident. However, despite the long experience in dealing with climatic variability in many arid and semi-arid countries, institutional rigidity persists and some of the most productive areas of contiguous irrigation are at risk from institutional failures as much as hydro-environmental constraints.

Table 3.6. Summary of key 2007 IPCC 4th Assessment for Agriculture by warming increments

Global mean annual temperature change relative to the 1980-99 (°C) baseline

Sub-sector	Region	+1°C to +2°C	+2°C to +3°C	+3°C to +5°C
Food crops	Global		550 ppm CO ₂ (approx. equal to +2°C) increases crop yield by 17%; this increase is offset by temperature increase of 2° C assuming no adaptation and 3° C with adaptation	
	Mid- to high latitudes	Cold limitation alleviated for all crops Adaptation of maize and wheat increases yield 10% to 15%; rice yield no change; regional variation is high	Adaptation increases all crops above baseline yield	
	Low latitudes	Wheat and maize yields reduced below baseline levels; rice is unchanged Adaptation of maize, wheat, rice, maintains yields at current levels	Adaptation maintains yields of all crops above baseline; yields drop below baseline for all crops without adaptation	Adaptation maintains yields of all crops above baseline; yield drops below baseline for all crops without adaptation Maize and wheat yields reduced below baseline regardless of adaptation, but adaptation maintains rice yield at baseline levels
Pastures and Livestock	Temperate	Cold limitation alleviated for pastures; seasonal increased frequency of heat stress for livestock	Moderate production loss in swine and confined cattle	
	Semi-arid	No increase in net primary productivity; seasonal increased frequency of heat stress for livestock	Reduction in animal weight and pasture production, and increased heat stress for livestock	
	Tropical			Strong production loss in swine and confined cattle
Fibre	Temperate		Yields decrease by 9%	
Real Agricultural Prices and Trade	Global	Real agricultural prices: -10% to -30%	Real agricultural prices: -10 to +30%	Real agricultural prices: +10 to +40% Cereal imports of developing countries to increase by 10-40%

conclusions are based on the quantitative projections across a range of emission scenarios used by the IPCC, while adaptation to climate change is not included in these estimations. For the full documentation on the methodologies and scenarios used by the IPCC, see reference below.

Source: Easterling *et al* 2007.

Many other reports from OECD government agencies have reinforced the IPCC view on climate change (e.g. Australia, CSIRO, 2008; Canada, Lemmen, *et al*, 2007; EU, European Parliament, 2008 and Portuguese Ministry of Environment, 2007; United States, USEPA, 2008). Overall these reports have indicated that in terms of the linkages between climate change, water resources and agriculture, farming systems are increasingly vulnerable to changes in water availability and temperature, as well the growing incidence and severity of flood and drought events, and this will require high levels of adaptive responses. In some situations climate change will also lead to beneficial opportunities for agriculture, such as an increase in wheat yield potential in Northern Europe and overall crop yields in North America.

Summary and key messages

So can agriculture meet the rising demand for food? This Chapter only provides a brief overview of some of the supply-side issues but it does suggest that production could be increased considerably. The three critical supply factors examined - land, productivity and water - do not appear to pose insurmountable barriers to increasing agricultural production. However, there are substantial risks that must be managed and investments that must be undertaken to ensure future food security. Moreover, growing societal concerns about the environment, intensive farming, use of GM technology, food quality, etc. will increasingly play a role in shaping the structure of agricultural production over the medium-term.

Bringing more land into production will involve higher costs and prices

There is substantial additional land available for use in agriculture. Most of the land available resides particularly in Sub-Saharan Africa (SSA) and South America. Relatively much less land is available in the currently high output zones of North America and Europe. In terms of numbers, of the world's land surface of some 13.2 billion hectares, about 4.3 billion are moderately to highly suitable as rainfed cropland. After adjustment for currently cultivated cropland of about 1.4 billion hectares and for forested and urban/protected areas, some 1560 million hectares remain available for cropland expansion.

Despite the availability of additional land, however, land use in agriculture has actually grown very slowly for decades, falling in some regions and growing in others, primarily in developing countries. The best rainfed cropland is already being used, and expansion to other areas would incur higher input costs on average. Existing land is also being used with increased cropping intensity as the practice of multiple-cropping has spread, particularly in areas where land is relatively scarce, such as in Asia. Infringement on forested areas would obviously make considerably more land available for agriculture but would incur high social and environmental costs. Existing land is being used more intensively in most regions, as the practice of multiple cropping has spread.

A key unanswered question is how much of the available cultivable land would actually be brought into production under given market conditions? Projected price levels may not be sufficient given the past record of higher value use elsewhere. If additional lower productivity land is brought into production, it is not clear what the potential additional output would be as this depends on the quality of the land in question. Additional analysis of the potential supply response is needed to address these critical issues.

Research and development is an investment priority

It would be a mistake to conclude that crop yields for major cereal, oilseed, and vegetable crops in all producing areas of OECD countries (or of the world) could match those of the most productive regions or that the trend rate of increase in crop yields is the same everywhere. However, evidence suggests that the rate of increase in crop yields has been constant over roughly half a century, and in particular, the rate of increase is not declining as some studies claim. A similar story can be made for global livestock production, at least based on available information up to 2001.

Public and private agricultural research capital and public agricultural extension can introduce new technologies that can enhance agricultural productivity. If the growth in public agricultural research expenditures is slowing, this may have predictions for future gains in agricultural productivity. Huffman (2009) suggests that the peak impact of R&D investment today on agricultural productivity will not occur for almost a decade. Thus, the foundations for new agricultural technologies of 2018 are being laid today. If investments in research are not keeping pace relative to those of recent decades, then agricultural TFP growth 10 years from now may be lower than observed today.

Reforming institutions and infrastructure is a necessary condition

If there is less technology internationally available from the world's leading national agricultural research stations, the effect on the urbanised countries may not be great. The Eastern and Central European countries have a long way to go to increase efficiency levels to match Northern Europe, so reorganisation matters more than technical progress.²⁷ In Latin America, countries such as Brazil and Argentina are industrialising and commercialising agriculture and have their own research capacity that may well increase yields as a result. They are almost certain to increase labour productivity as agriculture is mechanised and TFP should be driven by labour productivity growth. For the upper end of the transforming countries the same is true, as China and India have the research capacity to generate yield growth and the withdrawal of labour from agriculture will raise labour productivity and TFP.

It is the smaller countries, with less public research capacity and less industrialisation that may be at risk from productivity stagnation if they do not attract private technology providers. All TFP studies show that Sub-Saharan Africa (SSA) lags behind, but that productivity has been improving since the mid 1980s. The key seems to be institutions, incentives and better policy and infrastructure. It is efficiency change, rather than new technology and SSA could have reasonable growth in TFP and yields on this basis alone. A major difference between Asia and Africa is that in Asia, yield growth has been translated into increased labour productivity and better incomes. In SSA, yield increases have improved labour productivity very little, so there is a difficult question as to whether the relatively land abundant countries can follow a path of labour saving technical change.

Water use management in agriculture has to improve

Agriculture currently accounts for 44% of total OECD area water use, while for many countries the share is over 60%. Moreover, agriculture water use has been growing faster (2%) than for other water users (1%) between 1990-92 and 2002-04 for the OECD area. Changing dietary habits towards meat and dairy products in developing countries are key drivers impacting on water use by agriculture. In some regions, the expansion of biofuel and bioenergy production could place additional stress on water resources. The economic and environmental costs of agricultural water pollution are high, with the impacts of intensive groundwater use in agriculture constraining agricultural production, resulting in a wide range of social and environmental externalities.

The anticipated growth in world population to 9 billion by 2050 will involve a major expansion in demand for water, primarily for industrial uses but also in response to maintain the integrity and economic

²⁷ A recent FAO report noted that world average grain yields have risen by approximately 1.5% per year since 1991, with average annual gains ranging from 0.6% in Western Europe to 3.7% in Brazil. During the same period, both Ukraine and Kazakhstan experienced a decrease in grain yields while Russia remained stable. By 2016, grain yields in Russia, Kazakhstan and Ukraine are likely to increase by 11% (compared to 2004-2006 levels), due to better farm management, increased application of agricultural inputs and plant genetics. Still, the report suggested there is a much larger yield increase potential in these three countries considering soil quality, climatic conditions and current levels of productivity. (FAO, 2008).

value of increasing environmental services (e.g. wetlands). Some 44% of the world's population are already living in areas under severe water stress, mostly in non-OECD countries, and this share is projected to rise. Given that agriculture is the dominant water user in most countries, it will be crucial that agriculture substantially improves its efficiency in the use of water in the future.

Agriculture must adapt to climate change

Climate change will only add to the risks of water stress as well as the incidence and severity of floods. The IPPC suggests that with a 3-5°C increase in global mean annual temperatures, developing countries may need to increase cereal imports by 10-40% while real agricultural prices could be 10-40% higher. Asian, African and Middle Eastern countries will encounter the greatest pressure on water resources, especially from the future growth in non-agricultural water use. It is likely that OECD countries will continue to be a major source of farm exports to these countries, which in turn will necessitate OECD countries to further improve their management of water resources.

Two unknowns that will influence the future course of agricultural development centre on energy and the environment. If oil prices rise, agriculture will need to adjust to more expensive fertiliser, fuel and transport, while competition between food and biofuels could also become more intense. Rising concerns and government regulations over climate change, biodiversity and resource management will push agriculture towards greater sustainability and lower environmental costs. It remains to be seen how energy efficient technologies can be developed.

Investment in agriculture is necessary but insufficient for food security

Care also needs to be taken to the wider political, social and economic framework that would stimulate overall development, raise incomes and reduce poverty. In many cases, poverty is the underlying cause of food insecurity, and policies to improve the purchasing power of poor households through broad based economic development are essential. Hundreds of millions of people are simply not earning enough income to buy food that is otherwise available, be it at the high prices that prevailed in 2008 or at the much lower ones of a decade ago.

Within an objective of overall economic growth, the development of economically viable rural areas must be a primary policy objective to fight poverty and to manage migration flows from rural to urban areas. Agriculture can and should contribute to economic growth and rural development in developing countries along with other sectors that have high growth potential. Necessary conditions for agriculture to be an engine of growth usually include gains in productivity, integration of local and international markets and the creation of productive rural employment.

Fisheries sustainability is critical to overall food supplies

While not usually associated with the *Outlook* report, fisheries should be a consideration in any discussion about food security. Fish proteins accounted for 15% of total world animal protein supplies in 2003. Global fish production has increased about 8 times in volume since 1950 to reach some 145 million tonnes in 2006. Capture fisheries production has stabilized at 90-95 million tonnes over the past decade while aquaculture production has increased significantly and now contributes 36% of the total fish production. FAO and other organisations have projected total fish production to increase by 10-15% over the next ten years (Box 3.3).

The future potential of the industry is linked to the ability of policy makers to provide a conducive policy landscape for sustainable and profitable operations. In recent years, national and international policy debates have focused on sustainable and responsible fisheries and stock rebuilding, recognising that major fish stocks are either overexploited or at very high levels of exploitation.

Box 3.3. Fisheries and aquaculture: responding to the growing demand for food²⁸

Fish is highly nutritious, rich in micronutrients, minerals, essential fatty acids and proteins and therefore significantly contributes, quality-wise, to overall protein intake. Global per capita fish consumption has increased over the past four decades, rising to 16.4 kg in 2006. Regionally, two-thirds of the total food fish supplies is consumed in Asia (in particular, China) while under 5% is consumed in Africa. Fish consumption is closely related to income, among other things, with per capita fish consumption in developing countries at 14.4 kg in 2006 compared with 23.9 kg in developed countries.

Some 37% of fish production was traded internationally in 2004. The quantity of fish and fish products exported in 2004 was 53 million tonnes, a 13% increase compared to 1994. Over the same period, the value of exports increased by 51%, reaching a record value of USD 71.5 billion in 2004. Fish and fish products represent one of the most important commodity groups in the exports from developing countries. The share of fishery product exports in total agricultural trade (including forestry products) increased from 5% in 1976 to 14% in 2004 for these countries.

The FAO estimated fish production in 2020 to reach 163 million tonnes with aquaculture accounting for 70 million tonnes or 43%, up from 32% in 2004 (see Table below). A 2003 study by the International Food Policy Research Institute (IFPRI) estimated that total fish production would reach 170 million tonnes by 2020 (capture fisheries 116 million; aquaculture 54 million tonnes) with global per capita fish consumption increasing to 17.1 kg. It could be expected that the growing share of aquaculture may progressively increase competition for feed destined to livestock production.

Fish production in 2004 and projections

Information source	2004 FAO statistics ²	2010 SOFIA 2002 ³	2020 SOFIA 2002 ³	2020 IFPRI study ⁴
Total capture	95	93	93	116
Aquaculture	45.5	53	70	54
Total production	140.5	146	163	170
Percentage for food	75%	82%	85%	77%

Note: All figures - other than percentages - are in million tonnes.

²Based on latest statistics of the FAO Fishery Information, Data and Statistics Unit.

³FAO. 2002. *The State of World Fisheries and Aquaculture 2002*. Rome.

⁴International Food Policy research Institute. 2003. *Fish to 2020: supply and demand in changing global markets*, by C. Delgado, N. Wada, M. Rosegrant, S. Meijer and M. Ahmed. Washington, DC.

Source: FAO, SOFIA 2006.

Various measures and instruments have been developed to achieve sustainable fisheries such as the FAO Code of Conduct for Responsible Fisheries. The Code of Conduct emphasizes efforts to deter Illegal, Unregulated and Unreported (IUU) fishing. Regional high seas fisheries management organisations, as well as national governments, have been under pressure to establish more efficient systems to manage fishery resources in a sustainable and responsible manner and stop IUU fishing, through strengthening monitoring, control and surveillance activities. Various programmes have been established and implemented in light of the call of the World Summit on Sustainable Development in 2002 to rebuild fish stock to sustainable levels by 2015.

As many fisheries in OECD countries are characterised by excessive capacity (*i.e.* too many vessels and fishermen) decommissioning or buy-back programmes of fishing fleets, and accompanying policy measures, have been adopted as a means of restructuring national fishing fleets in many countries. In 2008, the OECD Council approved policy guidelines and best practices for the design and implementation of decommissioning schemes.

Many countries are investing heavily in the sector expecting that future demand for high quality seafood will be met by farmed fish. However, aquaculture has economic, environmental and social implications which may be poorly evaluated or inadequately addressed within current policy frameworks.

²⁸ Statistics in this Box are from the FAO if not otherwise indicated. Fisheries statistics are difficult to acquire and should be interpreted with caution.

For example, the availability of suitable sites for aquaculture is often cited as one of the constraining factors in the aquaculture industry in many OECD countries.

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Statistical Tables

I ECONOMIC ASSUMPTIONS

Calendar year (a)		Average	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
REAL GDP (b)		2006-08est.										
	Base		3.1	1.7	2.7	3.2	3.2	3.0	2.7	2.7	2.7	2.7
Australia (c)	Lower GDP-slow recovery	%	3.1	0.5	2.4	3.2	3.2	3.0	2.7	2.7	2.7	2.7
	Lower GDP-faster recovery		3.1	0.5	2.4	3.7	3.5	3.3	2.9	2.8	2.8	2.7
	Base		2.1	-0.5	2.1	2.8	2.5	2.5	2.4	2.4	2.4	2.4
Canada	Lower GDP-slow recovery	%	2.1	-3.0	0.3	2.8	2.5	2.5	2.4	2.4	2.4	2.4
	Lower GDP-faster recovery		2.1	-3.0	0.3	4.2	3.6	3.3	3.0	2.7	2.6	2.5
	Base		2.3	-0.5	1.2	2.4	2.4	2.3	2.2	2.2	2.2	2.2
European Union	Lower GDP-slow recovery	%	2.3	-4.1	-0.3	2.4	2.4	2.3	2.2	2.2	2.2	2.2
	Lower GDP-faster recovery		2.3	-4.1	-0.3	4.0	3.6	3.2	2.9	2.7	2.5	2.4
	Base		1.7	-0.1	0.6	1.2	1.2	1.1	1.1	1.1	1.1	1.1
Japan	Lower GDP-slow recovery	%	1.7	-6.6	-0.5	1.2	1.2	1.1	1.1	1.1	1.1	1.1
	Lower GDP-faster recovery		1.7	-6.6	-0.5	3.6	3.0	2.5	2.0	1.7	1.5	1.3
	Base		4.8	2.7	4.2	4.9	4.8	4.7	4.5	4.4	4.4	4.4
Korea (c)	Lower GDP-slow recovery	%	4.8	-4.0	3.2	4.9	4.8	4.7	4.5	4.4	4.4	4.4
	Lower GDP-faster recovery		4.8	-4.0	3.2	7.4	6.7	6.0	5.5	5.0	4.8	4.6
	Base		3.3	0.4	1.8	3.4	3.7	3.7	3.7	3.8	3.8	3.8
Mexico (c)	Lower GDP-slow recovery	%	3.3	-2.0	1.8	3.4	3.7	3.7	3.7	3.8	3.8	3.8
	Lower GDP-faster recovery		3.3	-2.0	1.8	4.1	4.3	4.2	4.0	4.0	3.9	3.8
	Base		1.6	-0.4	1.9	2.4	3.0	2.9	2.9	2.8	2.8	2.8
New Zealand (c)	Lower GDP-slow recovery	%	1.6	-1.2	1.2	2.4	3.0	2.9	2.9	2.8	2.8	2.8
	Lower GDP-faster recovery		1.6	-1.2	1.2	2.9	3.4	3.2	3.0	2.9	2.9	2.9
	Base		3.0	1.3	1.6	3.8	3.9	3.8	3.7	3.6	3.6	3.6
Norway	Lower GDP-slow recovery	%	3.0	-2.1	0.5	3.8	3.9	3.8	3.7	3.6	3.6	3.6
	Lower GDP-faster recovery		3.0	-2.1	0.5	5.3	5.0	4.6	4.2	3.9	3.8	3.7
	Base		2.9	-0.2	1.6	2.6	2.6	2.5	2.4	2.4	2.4	2.4
Switzerland	Lower GDP-slow recovery	%	2.9	-1.8	1.5	2.6	2.6	2.5	2.4	2.4	2.4	2.4
	Lower GDP-faster recovery		2.9	-1.8	1.5	3.2	3.0	2.8	2.6	2.5	2.4	2.4
	Base		4.8	1.7	4.9	4.7	4.6	4.6	4.6	4.6	4.6	4.6
Turkey	Lower GDP-slow recovery	%	4.8	-2.0	1.5	4.7	4.6	4.6	4.6	4.6	4.6	4.6
	Lower GDP-faster recovery		4.8	-2.0	1.5	6.9	6.3	5.8	5.4	5.1	4.9	4.8
	Base		2.1	-0.9	1.6	2.9	3.2	3.2	3.2	3.2	3.2	3.2
United States	Lower GDP-slow recovery	%	2.1	-4.0	0.0	2.9	3.2	3.2	3.2	3.2	3.2	3.2
	Lower GDP-faster recovery		2.1	-4.0	0.0	4.4	4.4	4.0	3.8	3.6	3.5	3.4
	Base		7.9	1.5	4.0	3.5	3.6	3.4	3.4	3.3	3.3	3.2
Argentina	Lower GDP-slow recovery	%	7.9	-1.8	1.9	3.5	3.6	3.4	3.4	3.3	3.3	3.2
	Lower GDP-faster recovery		7.9	-1.8	1.9	5.3	4.9	4.4	4.1	3.7	3.5	3.3
	Base		4.8	2.8	4.6	3.8	3.5	3.5	3.5	3.4	3.4	3.4
Brazil	Lower GDP-slow recovery	%	4.8	-0.3	3.8	3.8	3.5	3.5	3.5	3.4	3.4	3.4
	Lower GDP-faster recovery		4.8	-0.3	3.8	5.0	4.5	4.2	3.9	3.7	3.6	3.5
	Base		11.0	7.5	8.5	7.7	7.7	7.5	7.5	7.5	7.5	7.5
China	Lower GDP-slow recovery	%	11.0	6.3	8.5	7.7	7.7	7.5	7.5	7.5	7.5	7.5
	Lower GDP-faster recovery		11.0	6.3	8.5	8.0	7.9	7.7	7.6	7.6	7.6	7.5
	Base		8.3	5.8	7.7	7.0	6.9	6.9	6.8	6.8	6.8	6.8
India	Lower GDP-slow recovery	%	8.3	4.0	7.0	7.0	6.9	6.9	6.8	6.8	6.8	6.8
	Lower GDP-faster recovery		8.3	4.0	7.0	7.8	7.5	7.3	7.1	7.0	6.9	6.9
	Base		7.2	3.0	5.0	4.3	4.5	4.9	4.8	4.7	4.6	4.5
Russia	Lower GDP-slow recovery	%	7.2	-5.6	0.7	4.3	4.5	4.9	4.8	4.7	4.6	4.5
	Lower GDP-faster recovery		7.2	-5.6	0.7	8.6	7.7	7.2	6.4	5.7	5.2	4.9
	Base		4.6	2.8	4.4	4.1	4.2	4.3	4.3	4.3	4.3	4.3
South Africa	Lower GDP-slow recovery	%	4.6	1.6	3.4	4.1	4.2	4.3	4.3	4.3	4.3	4.3
	Lower GDP-faster recovery		4.6	1.6	3.4	4.7	4.7	4.7	4.6	4.5	4.4	4.4
	Base		2.3	-0.4	1.6	2.7	2.8	2.7	2.7	2.7	2.7	2.7
OECD (d) (e)	Lower GDP-slow recovery	%	2.3	-4.0	0.1	2.7	2.8	2.7	2.7	2.7	2.7	2.7
	Lower GDP-faster recovery		2.3	-4.0	0.1	4.3	4.0	3.6	3.3	3.1	3.0	2.9

For notes, see end of the table.

Source: OECD and FAO Secretariats.

I ECONOMIC ASSUMPTIONS (cont.d)

Calendar year (a)		2008est (million)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
POPULATION												
Australia	%	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9
Canada	%	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8
European Union	%	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Japan	%	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3
Korea	%	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0
Mexico	%	1.2	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9	0.8	0.8
New Zealand	%	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7
Norway	%	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Switzerland	%	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4
Turkey	%	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.9
United States	%	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8
Argentina	%	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.8
Brazil	%	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.9
China	%	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5
India	%	1.5	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.2	1.2	1.2
Russia	%	-0.5	-0.5	-0.5	-0.5	-0.5	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
South Africa	%	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
OECD (c)	%	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
World	%	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0

Calendar year (a)		Average 2006-08est.	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
PCE Deflator (b)												
Australia	%	3.1	3.6	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Canada	%	1.5	0.8	0.9	1.6	2.0	2.0	2.0	2.0	2.0	2.0	2.0
European Union	%	2.5	1.7	1.4	1.7	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Japan	%	-0.1	-0.2	-0.3	0.1	0.5	0.7	1.0	1.0	1.0	1.0	1.0
Korea	%	3.3	3.9	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Mexico	%	4.4	5.2	3.9	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
New Zealand	%	2.7	2.3	1.1	1.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Norway	%	2.1	2.7	1.8	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Switzerland	%	1.3	0.6	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Turkey	%	10.0	9.0	7.0	6.6	6.6	6.6	6.6	6.0	6.0	6.0	6.0
United States	%	3.0	1.2	1.3	1.4	1.6	1.7	1.9	1.9	1.9	1.9	1.9
Argentina	%	9.3	10.8	11.0	5.0	4.9	4.7	4.6	4.5	4.4	4.3	4.1
Brazil	%	4.2	4.8	4.8	4.0	4.6	4.2	4.3	4.3	4.3	4.3	4.3
China	%	4.5	5.5	4.5	4.2	4.0	3.9	3.8	3.7	3.6	3.4	3.3
India	%	6.9	6.1	5.0	4.1	4.1	4.1	4.1	4.5	4.5	4.5	4.5
Russia	%	11.9	11.0	8.0	9.2	8.1	7.7	7.3	6.9	6.6	6.3	5.9
South Africa	%	7.2	9.1	6.7	7.7	7.7	7.7	7.6	6.0	6.0	6.0	6.0
OECD (d,e)	%	2.9	2.1	1.8	1.9	2.2	2.3	2.4	2.3	2.3	2.4	2.4
EXCHANGE RATE												
Australia	AUD/USD	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3
Canada	CAD/USD	1.1	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1
European Union	EUR/USD	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Japan	JPY/USD	112.5	103.0	101.1	99.6	98.4	97.2	96.2	95.2	94.2	93.2	92.2
Korea	'000 KRW/USD	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Mexico	MXN/USD	11.0	11.4	11.6	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9
New Zealand	NZD/USD	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5
Argentina	ARS/USD	3.1	3.3	3.5	3.6	3.7	3.8	3.8	3.9	4.0	4.1	4.1
Brazil	BRL/USD	2.0	2.0	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.4	2.4
China	CNY/USD	7.5	6.7	6.3	6.3	6.2	6.2	6.2	6.2	6.2	6.2	6.2
India	INR/USD	43.3	47.2	46.2	47.7	49.1	50.6	51.9	53.3	54.7	56.2	57.7
Russia	RUR/USD	27.1	31.1	32.6	33.1	33.2	33.1	32.9	32.6	32.3	31.8	31.2
South Africa	ZAR/USD	7.3	9.0	9.2	9.6	10.0	10.5	10.9	11.4	11.8	12.3	12.8
WORLD OIL PRICE												
Brent crude oil price (f)	USD/barrel	79.0	43.3	54.5	60.7	61.9	63.1	64.3	65.5	66.7	67.9	69.1

a) For OECD member countries, historical data for population, real GDP, private consumption expenditure deflator and exchange rate were obtained from the OECD Economic Outlook No. 84, December 2008. For non-member economies, historical macroeconomic data were obtained from the World Bank, November 2008. Assumptions for the projection period draw on the recent medium term macroeconomic projections of the OECD Economics Department, projections of the World Bank, responses to a questionnaire sent to member country agricultural experts and for population, projections from the United Nations World Population Prospects Database, 2006 Revision (medium variant). Data for the European Union are for the euro area aggregates. b) Annual per cent change. The price index used is the private consumption expenditure deflator. c) Not available from ECO department. of OECD. Using World Bank short term update (31-03-2009). d) Excludes Iceland. e) Annual weighted average real GDP and CPI growth rates in OECD countries are based on weights using 1995 GDP and purchasing power parities (PPPs). f) Short term update for crude oil price from the Energy Information Administration.

Source: OECD and FAO Secretariats.

2 WORLD PRICES (a)

			<i>Average</i>										
			<i>06/07-08/09est.</i>	<i>09/10</i>	<i>10/11</i>	<i>11/12</i>	<i>12/13</i>	<i>13/14</i>	<i>14/15</i>	<i>15/16</i>	<i>16/17</i>	<i>17/18</i>	<i>18/19</i>
WHEAT													
Base			269.1	211.3	197.7	206.1	215.1	218.1	216.8	217.3	218.9	219.1	219.6
Lower GDP-slow recovery	Price (b)	USD/t	269.1	208.0	190.7	199.4	211.3	215.2	212.3	211.7	213.8	214.8	215.2
Lower GDP-faster recovery			269.1	208.0	190.7	201.0	215.1	219.7	216.4	215.9	218.4	219.7	220.1
COARSE GRAINS													
Base			184.9	164.1	160.4	166.4	172.5	170.9	172.1	173.9	168.0	165.1	165.1
Lower GDP-slow recovery	Price (c)	USD/t	184.9	158.7	149.8	158.2	168.1	165.6	165.0	166.8	161.7	159.0	158.9
Lower GDP-faster recovery			184.9	158.7	149.8	160.7	173.6	171.2	170.4	172.8	168.1	165.3	165.3
RICE													
Base			504.7	417.5	345.6	347.7	378.5	412.9	415.3	408.0	409.8	409.5	411.9
Lower GDP-slow recovery	Price (d)	USD/t	504.7	412.6	335.9	337.3	371.8	409.1	409.8	399.1	400.2	402.1	406.1
Lower GDP-faster recovery			504.7	412.6	335.8	339.5	377.5	416.2	416.0	405.3	407.3	410.1	414.1
OILSEEDS													
Base			440.7	334.4	344.5	357.6	385.5	375.9	373.0	383.8	392.5	391.0	398.2
Lower GDP-slow recovery	Price (e)	USD/t	440.7	326.9	333.3	348.6	379.3	370.3	365.8	375.6	384.8	383.9	390.9
Lower GDP-faster recovery			440.7	326.9	333.4	352.1	386.2	377.1	372.2	382.3	392.1	391.3	398.4
OILSEED MEALS													
Base			329.9	234.0	235.6	244.9	259.2	253.3	251.2	259.7	265.0	263.2	270.1
Lower GDP-slow recovery	Price (f)	USD/t	329.9	228.4	226.7	237.3	253.7	247.8	244.5	252.2	257.8	256.5	263.0
Lower GDP-faster recovery			329.9	228.4	226.7	239.6	258.7	253.0	249.7	258.1	264.4	263.2	270.0
VEGETABLE OILS													
Base			948.7	844.2	863.6	869.5	901.1	900.4	895.7	905.9	923.1	931.6	941.4
Lower GDP-slow recovery	Price (g)	USD/t	948.7	827.7	840.0	848.0	883.2	884.7	880.0	889.1	906.3	915.6	925.6
Lower GDP-faster recovery			948.7	827.7	840.5	856.6	898.3	901.9	896.9	905.8	923.3	932.7	942.8
SUGAR													
Base			278.1	297.5	305.6	312.7	317.0	310.1	301.3	303.3	302.4	303.8	307.6
Lower GDP-slow recovery	Price, raw sugar (h)	USD/t	278.1	288.8	290.6	296.5	302.4	297.7	290.1	292.3	291.6	293.2	296.6
Lower GDP-faster recovery			278.1	288.8	290.6	300.8	310.8	308.6	301.7	304.2	303.1	304.4	308.0
BEEF AND VEAL													
Base			319.4	323.3	299.3	299.5	318.3	322.4	332.5	330.7	328.0	324.8	325.0
Lower GDP-slow recovery	Price, USA (i)	USD/100 kg dw	319.4	292.5	271.3	282.0	303.6	311.0	323.3	321.6	318.9	316.1	316.2
Lower GDP-faster recovery			319.4	292.5	271.3	294.0	321.3	329.3	341.9	338.3	333.1	328.3	327.4
PIG MEAT													
Base			145.1	146.9	142.1	147.7	160.9	157.6	155.3	151.3	154.1	157.8	163.2
Lower GDP-slow recovery	Price, USA (j)	USD/100 kg dw	145.1	133.9	136.3	149.6	158.4	154.2	153.8	149.1	150.7	155.0	160.9
Lower GDP-faster recovery			145.1	133.9	136.3	155.8	163.6	156.3	156.8	152.2	153.3	157.7	163.9
POULTRY MEAT													
Base			162.0	179.0	165.7	162.4	167.5	168.6	177.7	177.8	175.8	172.2	174.1
Lower GDP-slow recovery	Price, USA (k)	USD/100 kg rtc	162.0	172.8	158.6	157.5	163.7	164.8	173.4	173.4	171.5	168.2	170.0
Lower GDP-faster recovery			162.0	172.8	158.6	159.9	167.5	168.8	177.7	177.8	175.9	172.5	174.3
SHEEP MEAT													
Base			332.9	324.1	319.8	329.2	338.2	340.7	349.9	355.7	361.5	369.0	374.8
Lower GDP-slow recovery	Price, New Zealand (l)	NZD/100 kg dw	332.9	324.1	319.8	329.2	338.2	340.7	349.9	355.7	361.5	369.0	374.8
Lower GDP-faster recovery			332.9	324.1	319.8	329.2	338.2	340.7	349.9	355.7	361.5	369.0	374.8
BUTTER													
Base			278.7	182.8	181.0	201.9	223.1	233.5	237.3	244.1	247.2	249.8	254.9
Lower GDP-slow recovery	Price (m)	USD/100 kg	278.7	158.3	149.3	169.5	189.1	201.0	206.2	210.6	211.3	213.2	218.5
Lower GDP-faster recovery			278.7	158.3	149.3	183.9	214.6	233.3	238.7	244.3	247.2	250.1	256.0
CHEESE													
Base			379.5	269.8	248.5	266.3	283.3	291.0	299.6	304.3	309.5	313.5	317.8
Lower GDP-slow recovery	Price (n)	USD/100 kg	379.5	252.1	229.5	248.4	266.5	275.8	284.2	288.4	293.5	297.2	301.5
Lower GDP-faster recovery			379.5	252.1	229.5	256.5	279.4	290.5	300.2	304.9	310.0	314.0	318.5
SKIM MILK POWDER													
Base			328.5	193.0	191.5	218.4	238.6	244.1	250.8	250.4	253.4	254.9	256.5
Lower GDP-slow recovery	Price (o)	USD/100 kg	328.5	184.7	181.3	212.8	231.9	238.1	244.3	244.1	246.9	248.9	250.3
Lower GDP-faster recovery			328.5	184.7	181.3	215.4	236.4	243.5	250.4	250.5	253.5	255.4	256.9
WHOLE MILK POWDER													
Base			342.2	190.3	196.2	219.7	234.5	246.4	256.0	258.4	262.0	265.0	268.6
Lower GDP-slow recovery	Price (p)	USD/100 kg	342.2	182.0	185.8	210.1	226.0	238.3	248.2	250.5	253.9	256.8	260.4
Lower GDP-faster recovery			342.2	182.0	185.8	214.2	233.4	247.1	257.3	259.6	262.9	265.7	269.3
ETHANOL													
Base			44.9	37.9	40.8	43.4	43.3	43.5	43.8	44.5	43.7	44.4	45.7
Lower GDP-slow recovery	Price (s)	USD/hl	44.9	37.4	39.7	42.6	43.0	43.1	43.3	44.0	43.5	44.1	45.4
Lower GDP-faster recovery			44.9	37.4	39.7	42.9	43.5	43.6	43.8	44.5	43.8	44.4	45.8
BIODIESEL													
Base			113.4	117.4	118.1	119.9	125.9	125.1	125.9	128.7	132.4	134.8	137.1
Lower GDP-slow recovery	Price (t)	USD/hl	113.4	116.8	115.9	117.4	124.1	123.6	124.4	127.1	130.8	133.3	135.6
Lower GDP-faster recovery			113.4	116.8	115.9	118.3	125.6	125.2	126.0	128.6	132.4	134.9	137.2

a) This table is a compilation of price information presented in the detailed commodity tables further in this annex. Prices for crops are on marketing year basis and those for meat and dairy products on calendar year basis (e.g. 07/08 is calendar year 2007). b) No.2 hard red winter wheat, ordinary protein, USA f.o.b. Gulf Ports (June/May), less EEP payments where applicable. c) No.2 yellow corn, US f.o.b. Gulf Ports (September/August). d) Milled, 100%, grade b, Nominal Price Quote, NPQ, f.o.b. Bangkok (August/July). e) Weighted average oilseed price, European port. f) Weighted average meal price, European port. g) Weighted average price of oilseed oils and palm oil, European port. h) Raw sugar world price, ICE Inc. No 11, f.o.b., bulk spot price (October/September). i) Choice steers, 1100-1300 lb lw, Nebraska - lw to dw conversion factor 0.63.

j) Barrows and gilts, No. 1-3, 230-250 lb lw, Iowa/South Minnesota - lw to dw conversion factor 0.74. k) Wholesale weighted average broiler price 12 cities. l) Lamb schedule price, all grade average. The price of sheep meat is an exogenous variable and does therefore not respond to any shocks. m) f.o.b. export price, butter, 82% butterfat, Oceania. n) f.o.b. export price, cheddar cheese, 39% moisture, Oceania. o) f.o.b. export price, non-fat dry milk, 1.25% butterfat, Oceania. p) f.o.b. export price, WMP 26% butterfat, Oceania. q) Edible dry whey, Wisconsin, plant. r) Export price, New Zealand. s) Brazil, Sao Paulo (ex-distillery). t) Producer price Germany net of biodiesel tariff.

est.: estimate.

Source: OECD and FAO Secretariats.

3 WORLD TRADE PROJECTIONS

IMPORTS		Average 2006-08est.	Base Average			Lower GDP-slow recovery Average			Lower GDP-faster recovery Average			
			2009-11	2012-2017	2018	2009-11	2012-2017	2018	2009-11	2012-2017	2018	
	World Trade	<i>kt</i>	113 737	118 820	126 131	133 876	118 514	125 619	133 438	118 522	126 029	133 967
Wheat	OECD	<i>kt</i>	24 283	25 115	25 935	26 450	25 160	25 986	26 496	25 160	25 945	26 441
	Developing	<i>kt</i>	90 811	95 388	102 069	109 376	95 049	101 525	108 915	95 060	101 957	109 467
	Least Developed Countries	<i>kt</i>	10 855	11 391	11 884	12 557	11 332	11 769	12 447	11 332	11 856	12 568
	World Trade	<i>kt</i>	119 253	117 929	121 227	127 960	117 785	121 433	128 336	117 782	121 211	128 185
Coarse Grains	OECD	<i>kt</i>	57 916	53 915	53 127	53 067	52 823	51 976	52 052	52 922	53 020	53 225
	Developing	<i>kt</i>	79 448	83 947	88 948	96 600	84 753	90 267	98 000	84 687	89 122	96 726
	Least Developed Countries	<i>kt</i>	2 138	2 436	4 247	6 056	2 479	4 901	6 143	2 475	4 253	6 050
	World Trade	<i>kt</i>	31 807	34 238	36 769	38 692	33 976	36 326	38 215	34 018	36 672	38 657
Rice	OECD	<i>kt</i>	4 786	4 866	5 271	5 560	4 863	5 263	5 551	4 864	5 268	5 555
	Developing	<i>kt</i>	26 808	29 011	31 226	32 867	28 787	30 836	32 447	28 823	31 142	32 838
	Least Developed Countries	<i>kt</i>	6 988	7 458	7 346	7 707	7 405	7 268	7 628	7 414	7 331	7 703
	World Trade	<i>kt</i>	85 162	92 835	99 676	104 557	92 417	98 808	103 615	92 430	99 404	104 522
Oilseeds	OECD	<i>kt</i>	34 930	35 066	35 052	35 614	34 665	34 431	34 928	34 695	34 859	35 575
	Developing	<i>kt</i>	57 554	65 204	72 320	77 106	65 181	72 015	76 787	65 166	72 222	77 108
	Least Developed Countries	<i>kt</i>	281	357	415	466	360	417	467	360	416	466
	World Trade	<i>kt</i>	58 524	66 775	72 869	80 320	67 110	73 273	80 771	67 092	72 927	80 342
Oilseed Meals	OECD	<i>kt</i>	33 444	36 994	36 312	36 046	37 268	36 468	36 197	37 256	36 314	36 049
	Developing	<i>kt</i>	25 666	30 715	37 387	44 943	30 629	37 516	45 118	30 642	37 431	44 960
	Least Developed Countries	<i>kt</i>	325	402	515	614	403	511	611	403	514	614
	World Trade	<i>kt</i>	48 633	54 142	64 325	73 127	54 117	64 038	72 754	54 122	64 210	73 092
Vegetable Oils	OECD	<i>kt</i>	12 891	16 078	20 512	24 164	16 024	20 341	23 969	16 051	20 478	24 158
	Developing	<i>kt</i>	35 129	37 355	42 899	47 870	37 356	42 766	47 675	37 342	42 818	47 841
	Least Developed Countries	<i>kt</i>	3 912	4 320	5 200	5 979	4 293	5 157	5 924	4 297	5 193	5 977
	World Trade	<i>kt</i>	47 440	54 050	59 742	63 792	53 714	59 188	63 199	53 766	59 636	63 795
Sugar	OECD	<i>kt</i>	10 927	12 296	13 290	13 764	12 254	13 253	13 707	12 260	13 294	13 763
	Developing	<i>kt</i>	31 885	36 480	41 968	46 345	36 767	42 139	46 478	36 736	41 977	46 350
	Least Developed Countries	<i>kt</i>	5 955	6 870	8 478	10 062	6 891	8 485	10 051	6 889	8 488	10 063
	World Trade	<i>kt</i>	7 112	7 516	8 684	9 449	7 261	8 372	9 168	7 262	8 571	9 453
Beef (a)	OECD	<i>kt</i>	3 278	3 219	3 679	4 060	3 087	3 444	3 804	3 094	3 610	4 053
	Developing	<i>kt</i>	3 470	3 901	4 754	5 333	3 999	4 732	5 260	3 986	4 710	5 314
	Least Developed Countries	<i>kt</i>	152	214	301	336	216	304	337	216	301	334
	World Trade	<i>kt</i>	5 356	5 370	5 891	6 424	5 082	5 462	5 863	5 108	5 777	6 411
Pigmeat (a)	OECD	<i>kt</i>	2 876	3 119	3 501	3 822	2 859	3 186	3 487	2 884	3 430	3 811
	Developing	<i>kt</i>	2 199	2 351	2 760	3 212	2 235	2 584	2 916	2 242	2 707	3 204
	Least Developed Countries	<i>kt</i>	73	73	104	114	73	105	114	73	104	114
	World Trade	<i>kt</i>	9 310	10 148	11 258	12 312	10 343	11 428	12 572	10 320	11 263	12 308
Poultry	OECD	<i>kt</i>	2 291	2 452	2 710	2 784	2 737	3 089	3 227	2 718	2 798	2 788
	Developing	<i>kt</i>	5 701	6 649	7 661	8 827	6 798	7 765	8 817	6 791	7 667	8 819
	Least Developed Countries	<i>kt</i>	499	541	757	960	533	737	927	534	754	961
	World Trade	<i>kt</i>	905	876	893	917	844	838	862	846	875	914
Butter	OECD	<i>kt</i>	152	143	149	153	143	149	153	143	149	153
	Developing	<i>kt</i>	445	471	498	529	539	571	609	528	504	525
	Least Developed Countries	<i>kt</i>	11	18	18	22	22	21	28	21	18	22
	World Trade	<i>kt</i>	1 549	1 658	1 880	2 109	1 585	1 729	1 942	1 592	1 882	2 142
Cheese	OECD	<i>kt</i>	719	699	778	839	690	767	828	691	776	839
	Developing	<i>kt</i>	612	687	796	882	759	833	914	749	834	915
	Least Developed Countries	<i>kt</i>	13	32	36	44	35	38	48	34	36	44
	World Trade	<i>kt</i>	1 687	1 897	2 207	2 460	1 899	2 189	2 438	1 898	2 195	2 456
Whole Milk Powder	OECD	<i>kt</i>	96	97	97	97	98	98	98	98	97	97
	Developing	<i>kt</i>	1 585	1 790	2 100	2 353	1 811	2 104	2 354	1 808	2 093	2 349
	Least Developed Countries	<i>kt</i>	175	230	295	353	230	292	349	230	294	353
	World Trade	<i>kt</i>	1 134	1 214	1 290	1 362	1 198	1 257	1 327	1 201	1 286	1 365
Skim Milk Powder	OECD	<i>kt</i>	193	194	212	227	196	213	228	196	212	227
	Developing	<i>kt</i>	1 004	1 097	1 182	1 258	1 103	1 178	1 253	1 104	1 183	1 261
	Least Developed Countries	<i>kt</i>	41	43	46	51	43	46	50	43	46	51

For notes, see end of the table.

Source: OECD and FAO Secretariats.

3 WORLD TRADE PROJECTIONS (cont.)

EXPORTS			Average 2006-08est.	Base			Lower GDP-slow recovery			Lower GDP-faster recovery		
				Average			Average			Average		
				2009-11	2012-2017	2018	2009-11	2012-2017	2018	2009-11	2012-2017	2018
Wheat	OECD	kt	71 792	78 471	83 569	86 145	76 770	81 490	83 873	76 935	83 210	86 159
	Developing	kt	17 802	17 004	18 665	20 279	17 010	18 670	20 281	17 010	18 672	20 297
	Least Developed Countries	kt	84	32	27	29	32	27	29	32	27	29
Coarse Grains	OECD	kt	80 257	71 264	72 637	78 516	72 326	73 663	79 794	72 223	72 762	78 636
	Developing	kt	29 932	30 027	31 213	31 615	29 228	30 709	30 861	29 325	31 187	31 731
	Least Developed Countries	kt	2 500	2 861	3 330	4 360	2 603	3 812	4 342	2 624	3 286	4 348
Rice	OECD	kt	3 713	4 002	4 336	4 583	4 092	4 437	4 676	4 087	4 357	4 580
	Developing	kt	27 368	29 551	31 731	33 402	29 300	31 284	32 928	29 318	31 623	33 371
	Least Developed Countries	kt	1 473	1 624	2 517	3 364	1 570	2 417	3 240	1 574	2 490	3 348
Oilseeds	OECD	kt	40 712	45 782	43 598	43 027	45 732	44 240	43 710	45 768	43 852	42 989
	Developing	kt	41 051	42 882	50 980	55 659	42 537	49 534	54 098	42 523	50 472	55 661
	Least Developed Countries	kt	18	18	18	18	18	18	18	18	18	18
Oilseeds Meals	OECD	kt	10 855	14 118	16 929	19 974	14 793	17 294	20 334	14 743	16 913	19 970
	Developing	kt	50 715	55 242	58 277	62 477	54 915	58 292	62 506	54 949	58 336	62 493
	Least Developed Countries	kt	19	19	19	20	19	19	20	19	19	20
Vegetable Oils	OECD	kt	3 143	3 373	3 581	4 578	3 452	3 583	4 571	3 444	3 568	4 583
	Developing	kt	42 788	47 137	56 348	63 528	46 934	55 932	63 030	46 956	56 220	63 487
	Least Developed Countries	kt	87	90	96	101	90	96	101	90	96	101
Sugar	OECD	kt	6 322	6 164	6 460	6 428	6 138	6 461	6 414	6 149	6 473	6 425
	Developing	kt	42 459	48 639	54 625	58 562	48 352	54 117	58 033	48 391	54 537	58 582
	Least Developed Countries	kt	2 171	2 351	2 536	2 764	2 441	2 641	2 865	2 435	2 550	2 759
Beef (a)	OECD	kt	3 354	3 800	4 026	4 280	3 748	3 846	4 079	3 742	3 945	4 266
	Developing	kt	4 167	4 466	5 569	6 180	4 299	5 457	6 120	4 300	5 535	6 197
	Least Developed Countries	kt	2	3	3	3	3	3	3	3	3	3
Pigmeat (a)	OECD	kt	4 374	4 224	4 518	4 706	3 966	4 165	4 327	3 987	4 427	4 687
	Developing	kt	1 284	1 294	1 555	1 834	1 244	1 457	1 630	1 252	1 531	1 840
	Least Developed Countries	kt	0	1	0	0	1	0	0	1	0	0
Poultry	OECD	kt	4 121	4 252	4 432	4 578	4 137	4 345	4 494	4 152	4 431	4 584
	Developing	kt	5 258	5 986	7 013	7 972	6 295	7 260	8 306	6 257	7 018	7 963
	Least Developed Countries	kt	6	7	8	10	8	8	10	8	8	10
Butter	OECD	kt	698	663	663	680	648	624	638	650	650	677
	Developing	kt	88	95	108	114	80	96	106	81	105	113
	Least Developed Countries	kt	0	1	2	1	1	1	1	1	2	1
Cheese	OECD	kt	1 258	1 310	1 398	1 451	1 291	1 329	1 374	1 292	1 379	1 445
	Developing	kt	326	358	462	529	304	387	440	311	488	564
	Least Developed Countries	kt	0	0	1	1	0	1	1	0	1	1
Whole Milk Powder	OECD	kt	1 191	1 271	1 370	1 458	1 268	1 355	1 445	1 268	1 360	1 455
	Developing	kt	592	719	927	1 090	722	923	1 080	722	925	1 088
	Least Developed Countries	kt	7	10	15	19	10	15	19	10	15	19
Skim Milk Powder	OECD	kt	976	920	967	1 023	906	937	992	909	961	1 023
	Developing	kt	128	151	182	202	146	175	194	147	183	206
	Least Developed Countries	kt	1	1	0	0	1	0	0	1	0	0
Biofuel (b)	Ethanol World Trade	Mil l	4 892	4 989	8 818	13 077	4 660	8 708	13 093	4 697	8 820	13 059
	Biodiesel World Trade	Mil l	2 096	4 034	5 533	6 711	4 051	5 538	6 726	4 051	5 537	6 717

a) Excludes trade of live animals. b) Sum of all positive net trade positions est.: estimate.

Source: OECD and FAO Secretariats.

Crop year (a)		Average 2006-08est.	Base Average			Lower GDP-slow recovery Average			Lower GDP-faster recovery Average		
			2009-11	2012-2017	2018	2009-11	2012-2017	2018	2009-11	2012-2017	2018
WHEAT											
OECD (b)											
Production	mt	253.1	271.6	286.2	296.1	269.7	283.7	293.7	269.8	285.7	296.3
Consumption	mt	207.3	217.1	226.8	234.6	217.1	226.5	234.3	217.1	226.6	234.5
Closing stocks	mt	49.8	64.7	71.5	77.5	64.7	71.0	77.1	64.7	71.2	77.5
Non-OECD											
Production	mt	375.8	390.0	410.9	426.3	388.9	409.4	424.8	389.0	410.6	426.3
Consumption	mt	421.4	442.9	467.1	484.3	440.3	463.5	480.4	440.6	466.3	484.1
Closing stocks	mt	124.1	130.9	135.9	140.2	131.1	135.5	139.9	131.0	135.6	140.2
WORLD (c)											
Production	mt	628.9	661.6	697.1	722.4	658.7	693.2	718.5	658.8	696.3	722.7
Consumption	mt	628.8	660.0	694.0	718.9	657.4	690.0	714.7	657.7	693.0	718.6
Closing stocks	mt	174.0	195.5	207.4	217.7	195.8	206.5	217.0	195.7	206.9	217.8
Price (d)	USD/t	269.1	205.0	217.5	219.6	199.3	213.2	215.2	199.9	217.5	220.1
COARSE GRAINS											
OECD (b)											
Production	mt	545.1	592.5	638.8	668.4	589.4	633.8	663.3	589.5	637.4	668.5
Consumption	mt	528.9	579.1	616.8	638.4	573.7	609.8	630.9	574.2	615.3	638.3
Closing stocks	mt	97.6	96.8	96.4	111.1	98.7	96.3	111.0	98.4	95.7	110.8
Non-OECD											
Production	mt	511.0	542.0	585.3	615.2	538.6	580.2	609.8	538.7	584.2	615.3
Consumption	mt	522.7	559.5	600.9	637.6	558.6	597.9	634.4	558.7	599.8	637.5
Closing stocks	mt	145.6	153.1	169.3	181.8	153.2	168.7	181.3	153.0	169.0	181.8
WORLD (c)											
Production	mt	1056.1	1134.4	1224.1	1283.6	1128.0	1214.0	1273.1	1128.2	1221.6	1283.7
Consumption	mt	1051.6	1138.7	1217.7	1276.0	1132.3	1207.7	1265.3	1132.9	1215.1	1275.8
Closing stocks	mt	243.2	249.9	265.7	292.9	251.8	265.0	292.3	251.5	264.7	292.6
Price (e)	USD/t	184.9	163.6	170.4	165.1	155.6	164.4	158.9	156.4	170.2	165.3
RICE											
OECD (b)											
Production	mt	21.4	22.4	22.5	22.7	22.5	22.6	22.8	22.5	22.6	22.7
Consumption	mt	22.8	23.0	23.3	23.6	23.1	23.3	23.6	23.1	23.3	23.6
Closing stocks	mt	5.7	6.2	6.8	7.4	6.1	6.8	7.4	6.1	6.9	7.5
Non-OECD											
Production	mt	420.7	439.0	456.4	471.6	437.7	454.5	469.6	437.8	456.0	471.6
Consumption	mt	417.6	437.2	455.5	471.2	435.9	453.6	469.1	436.1	455.1	471.0
Closing stocks	mt	85.9	96.2	98.6	100.5	96.4	98.3	100.1	96.3	98.4	100.3
WORLD (c)											
Production	mt	442.1	461.4	478.9	494.4	460.1	477.1	492.3	460.2	478.5	494.3
Consumption	mt	440.4	460.2	478.8	494.8	459.1	477.0	492.7	459.2	478.4	494.6
Closing stocks	mt	91.6	102.4	105.5	107.9	102.5	105.1	107.5	102.4	105.3	107.9
Price (f)	USD/t	504.7	370.3	405.7	411.9	361.9	398.7	406.1	362.6	405.4	414.1

a) Beginning crop marketing year - see Glossary of Terms for definitions. b) Excludes Iceland but includes the 8 EU members that are not members of the OECD. c) Source of historic data is USDA. d) No.2 hard red winter wheat, ordinary protein, USA f.o.b. Gulf Ports (June/May), less EEP payments where applicable. e) No.2 yellow corn, US f.o.b. Gulf Ports (September/August). f) Milled, 100%, grade b, Nominal Price Quote, NPQ, f.o.b. Bangkok (August/July)

est.: estimate.

Source: OECD and FAO Secretariats.

		Average 2006-08est.	Base Average			Lower GDP-slow recovery Average			Lower GDP-faster recovery Average		
			2009-11	2012-2017	2018	2009-11	2012-2017	2018	2009-11	2012-2017	2018
OILSEEDS (Crop Year (a))											
OECD (b)											
Production	mt	123.1	136.4	142.9	151.0	135.9	142.3	150.4	135.9	142.8	151.0
Consumption	mt	119.6	125.2	134.4	143.7	124.3	132.5	141.7	124.4	133.8	143.7
crush	mt	109.3	114.5	123.6	132.7	113.6	121.9	130.9	113.7	123.1	132.7
Closing stocks	mt	16.8	15.6	15.2	15.2	15.9	15.1	15.2	15.8	15.1	15.2
Non-OECD											
Production	mt	184.5	207.4	234.8	255.8	206.3	232.5	253.4	206.3	234.1	255.8
Consumption	mt	191.0	219.2	244.3	264.2	218.5	243.3	263.2	218.6	244.1	264.2
crush	mt	164.2	187.4	210.6	229.1	186.7	209.7	228.2	186.8	210.5	229.2
Closing stocks	mt	12.3	12.8	12.2	12.1	12.9	12.2	12.1	12.9	12.2	12.1
WORLD (c)											
Production	mt	307.6	343.8	377.7	406.8	342.1	374.8	403.8	342.2	377.0	406.8
Consumption	mt	310.6	344.5	378.6	407.9	342.8	375.8	404.9	342.9	377.9	407.9
crush	mt	273.5	301.9	334.2	361.9	300.4	331.6	359.1	300.5	333.6	361.9
Closing stocks	mt	29.1	28.4	27.4	27.3	28.7	27.3	27.3	28.7	27.2	27.3
Price (d)	USD/t	440.7	345.5	383.6	398.2	336.3	376.6	390.9	337.4	383.5	398.4
OILSEED MEALS (marketing year)											
OECD (b)											
Production	mt	78.3	81.3	87.7	94.2	80.7	86.5	92.9	80.8	87.3	94.1
Consumption	mt	100.9	104.1	107.1	110.2	103.2	105.7	108.7	103.3	106.7	110.2
Closing stocks	mt	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Non-OECD											
Production	mt	118.0	134.6	151.4	164.7	134.1	150.7	164.0	134.2	151.2	164.7
Consumption	mt	89.8	106.3	126.5	143.2	106.2	126.1	142.7	106.2	126.4	143.2
Closing stocks	mt	5.3	5.2	5.2	5.2	5.2	5.1	5.2	5.2	5.1	5.2
WORLD (c)											
Production	mt	196.3	215.9	239.0	258.9	214.8	237.2	256.9	214.9	238.5	258.8
Consumption	mt	190.6	210.4	233.6	253.4	209.4	231.7	251.5	209.5	233.1	253.4
Closing stocks	mt	6.5	6.5	6.4	6.4	6.5	6.4	6.4	6.5	6.4	6.4
Price (e)	USD/t	329.9	238.2	258.6	270.1	230.8	252.1	263.0	231.5	257.8	270.0
VEGETABLE OILS (marketing year)											
OECD (b)											
Production	mt	27.9	30.1	32.8	35.3	29.8	32.3	34.8	29.8	32.6	35.3
Consumption	mt	37.8	42.8	49.7	54.9	42.4	49.0	54.2	42.5	49.5	54.9
Closing stocks	mt	2.6	2.3	2.5	2.5	2.3	2.4	2.4	2.3	2.4	2.5
Non-OECD											
Production	mt	79.7	91.5	107.3	119.7	91.1	106.7	118.9	91.1	107.1	119.6
Consumption	mt	70.0	79.0	90.7	100.4	78.8	90.2	99.8	78.8	90.5	100.3
Closing stocks	mt	6.8	7.6	8.4	9.1	7.6	8.4	9.1	7.6	8.4	9.1
WORLD (c)											
Production	mt	107.6	121.6	140.1	155.0	120.9	138.9	153.7	121.0	139.8	154.9
of which palm oil	mt	42.1	48.3	58.6	66.5	48.1	58.1	65.9	48.1	58.4	66.4
Consumption	mt	107.7	121.9	140.4	155.3	121.3	139.2	154.0	121.3	140.0	155.2
Closing stocks	mt	9.4	10.0	10.9	11.6	10.0	10.8	11.5	10.0	10.9	11.6
Oil price (f)	USD/t	948.7	859.1	909.6	941.4	838.5	893.2	925.6	841.6	909.8	942.8

a) Beginning crop marketing year - see Glossary of Terms for definitions. b) Excludes Iceland but includes the 8 EU members that are not members of the OECD. c) Source of historic data is USDA. d) Weighted average oilseed price, European port. e) Weighted average meal price, European port. f) Weighted average price of oilseed oils and palm oil, European port.

est: estimation.

Source: OECD and FAO Secretariats.

Crop year (a)	Average 2006-08est.	Base Average			Lower GDP-slow recovery Average			Lower GDP-faster recovery Average			
		2009-11	2012-2017	2018	2009-11	2012-2017	2018	2009-11	2012-2017	2018	
OECD											
Production	kt rse	35 954	34 515	35 033	35 303	34 295	34 936	35 266	34 317	35 035	35 327
Consumption	kt rse	40 483	40 637	41 413	41 959	40 063	40 870	41 456	40 126	41 331	41 981
Closing stocks	kt rse	18 833	18 247	17 327	17 176	18 829	19 359	20 344	18 790	18 395	18 310
NON-OECD											
Production	kt rse	130 408	139 996	152 875	166 231	138 339	150 676	163 770	138 513	152 466	166 215
Consumption	kt rse	119 010	130 005	144 482	156 452	128 326	142 416	154 070	128 547	144 103	156 410
Closing stocks	kt rse	59 033	61 051	65 261	64 218	61 269	65 027	63 733	61 227	65 105	64 107
WORLD											
Production	kt rse	166 362	174 511	187 908	201 534	172 634	185 612	199 035	172 830	187 500	201 542
Consumption	kt rse	159 492	170 642	185 895	198 411	168 389	183 286	195 526	168 673	185 434	198 391
Closing stocks	kt rse	77 866	79 298	82 588	81 394	80 098	84 386	84 077	80 016	83 500	82 416
Price, raw sugar (b)	USD/t	278.1	305.3	306.3	307.6	292.0	294.6	296.6	293.4	305.5	308.0
Price, white sugar (c)	USD/t	333.0	338.1	353.6	371.5	325.2	342.1	360.7	326.5	352.8	371.9

a) Beginning crop marketing year - see the Glossary of Terms for definitions. b) Raw sugar world price, New York No 11, f.o.b. stowed Caribbean port (including Brazil), bulk spot price, October/September. c) Raw sugar world price, ICE Inc. No 11, f.o.b., bulk spot price (October/September).

est: estimate.

Source: OECD and FAO Secretariats.

Calendar year (a)	Average 2006-08est.	Base			Lower GDP-slow recovery			Lower GDP-faster recovery			
		Average 2009-11	2012-2017	2018	Average 2009-11	2012-2017	2018	Average 2009-11	2012-2017	2018	
OECD (b)											
BEEF AND VEAL											
Production	kt cwe	27 127	27 195	27 254	27 997	27 023	26 721	27 408	27 028	27 014	27 952
Consumption	kt cwe	27 049	26 612	26 907	27 776	26 360	26 319	27 132	26 378	26 677	27 739
Ending stocks	kt cwe	1 019	1 014	1 013	1 012	1 014	1 012	1 011	1 014	1 012	1 012
Per capita consumption	kg rwt	15.4	15.0	14.8	15.1	14.8	14.5	14.7	14.8	14.7	15.1
Price, EU	EUR/100 kg dw	305	257	276	281	248	271	277	249	277	282
Price, USA (c)	USD/100 kg dw	319	307	326	325	282	316	316	286	332	327
Price, Brazil (d)	USD/100 kg dw	211	195	196	197	184	192	194	185	198	197
PIG MEAT											
Production	kt cwe	38 340	38 511	39 620	40 861	37 932	38 991	40 205	37 962	39 530	40 860
Consumption	kt cwe	36 671	37 187	38 405	39 761	36 620	37 814	39 152	36 658	38 328	39 767
Ending stocks	kt cwe	917	993	974	970	990	974	968	985	977	969
Per capita consumption	kg rwt	23.3	23.3	23.5	24.0	22.9	23.2	23.7	22.9	23.5	24.0
Price, EU (e)	EUR/100 kg dw	143	131	137	136	125	132	132	126	137	136
Price, USA (f)	USD/100 kg dw	145	146	156	163	140	154	161	142	157	164
POULTRY MEAT											
Production	kt rtc	38 202	39 220	41 188	42 775	38 591	40 575	42 155	38 672	41 114	42 795
Consumption	kt rtc	36 353	37 435	39 465	40 979	37 205	39 318	40 886	37 252	39 480	40 998
Ending stocks	kt rtc	1 158	1 202	1 199	1 202	1 202	1 199	1 202	1 202	1 199	1 202
Per capita consumption	kg rwt	26.1	26.4	27.3	28.0	26.3	27.2	27.9	26.3	27.3	28.0
Price, EU (g)	EUR/100 kg rtc	115	113	112	108	111	110	107	112	111	108
Price, USA (h)	USD/100 kg rtc	162	169	173	174	163	169	170	164	173	174
SHEEP MEAT											
Production	kt cwe	2 830	2 696	2 741	2 781	2 653	2 695	2 734	2 658	2 733	2 781
Consumption	kt cwe	2 429	2 316	2 315	2 313	2 248	2 248	2 250	2 256	2 305	2 314
Ending stocks	kt cwe	527	519	498	503	519	498	503	519	498	503
Per capita consumption	kg rwt	1.7	1.6	1.6	1.6	1.6	1.6	1.5	1.6	1.6	1.6
Price, Australia (i)	AUD/100 kg dw	331	348	357	363	348	357	363	348	357	363
Price, Australia (j)	AUD/100 kg dw	149	159	153	148	159	153	148	159	153	148
Price, New Zealand (k)	NZD/100 kg dw	333	324	353	375	324	353	375	324	353	375
TOTAL MEAT											
Per capita consumption	kg rwt	66.6	66.3	67.3	68.7	65.6	66.4	67.8	65.7	67.1	68.7
Non-OECD											
BEEF AND VEAL											
Production	kt cwe	37 605	39 476	43 171	46 100	39 071	42 312	45 152	39 104	42 861	46 049
Consumption	kt cwe	37 303	39 665	43 122	45 893	39 331	42 317	45 001	39 352	42 805	45 836
Per capita consumption	kg rwt	4.8	4.9	5.0	5.1	4.8	4.9	5.0	4.9	5.0	5.1
Ending stocks	kt cwe	87	98	92	78	98	92	78	98	92	78
PIG MEAT											
Production	kt cwe	62 123	66 750	73 845	79 028	66 445	73 389	78 501	66 462	73 735	78 988
Consumption	kt cwe	63 461	67 765	74 772	79 817	67 463	74 279	79 247	67 477	74 642	79 769
Per capita consumption	kg rwt	9.1	9.3	9.7	10.0	9.3	9.7	9.9	9.3	9.7	10.0
Ending stocks	kt cwe	46	46	46	46	46	46	46	46	46	46
POULTRY MEAT											
Production	kt rtc	51 654	60 980	70 368	77 528	60 608	69 926	77 054	60 688	70 319	77 529
Consumption	kt rtc	53 440	62 709	72 019	79 252	61 937	71 111	78 250	62 051	71 882	79 254
Per capita consumption	kg rwt	8.6	9.7	10.6	11.2	9.6	10.4	11.0	9.6	10.5	11.2
Ending stocks	kt rtc	142	110	114	116	110	114	116	110	114	116
SHEEP MEAT											
Production	kt cwe	9 477	10 080	11 017	11 723	10 048	10 960	11 661	10 050	11 001	11 722
Consumption	kt cwe	9 860	10 520	11 668	12 518	10 433	11 552	12 394	10 441	11 642	12 517
Per capita consumption	kg rwt	1.6	1.6	1.7	1.8	1.6	1.7	1.7	1.6	1.7	1.8
Ending stocks	kt cwe	5	5	5	5	5	5	5	5	5	5
TOTAL MEAT											
Per capita consumption	kg rwt	24.0	25.6	27.0	28.0	25.3	26.7	27.7	25.4	26.9	28.0

a) Year ending 30 September for New Zealand b) Excludes Iceland but includes the 8 EU members that are not members of the OECD. Carcass weight to retail weight conversion factors of 0.7 for beef and veal, 0.78 for pig meat and 0.88 for sheep meat. Rtc to retail weight conversion factor 0.88 for poultry meat. c) Choice steers, 1100-1300 lb lw, Nebraska - lw to dw conversion factor 0.63. d) Price received by producer. e) Pig producer price. f) Barrows and gilts, No. 1-3, 230-250 lb lw, Iowa/South Minnesota - lw to dw conversion factor 0.74. g) Poultry producer price (lw to rtc conversion of 0.75). h) Wholesale weighted average broiler price 12 cities. i) Saleyard price, lamb, 16-20 kg dw. j) Saleyard price, wethers, < 22kg dw.

k) Lamb schedule price, all grade average.

est.: estimate.

Source : OECD and FAO Secretariats

Calendar year (a)		Average	Base			Lower GDP-slow recovery			Lower GDP-faster recovery		
		2006-08est.	Average			Average			Average		
			2009-11	2012-2017	2018	2009-11	2012-2017	2018	2009-11	2012-2017	2018
BUTTER											
OECD (b)											
Production	kt pw	3 684	3 715	3 697	3 726	3 703	3 662	3 687	3 704	3 684	3 722
Consumption	kt pw	3 181	3 244	3 228	3 231	3 248	3 231	3 236	3 246	3 227	3 231
Stock changes	kt pw	-24	-20	-15	-3	-20	-15	-3	-20	-15	-3
Non-OECD											
Production	kt pw	5 581	6 672	7 772	8 694	6 599	7 670	8 590	6 603	7 745	8 701
Consumption	kt pw	6 184	7 233	8 327	9 262	7 146	8 186	9 115	7 151	8 288	9 266
WORLD											
Production	kt pw	9 266	10 387	11 469	12 419	10 303	11 332	12 278	10 307	11 429	12 423
Consumption	kt pw	9 365	10 477	11 554	12 493	10 393	11 418	12 351	10 398	11 515	12 497
Stock changes	kt pw	-32	-20	-15	-3	-20	-15	-3	-20	-15	-3
Price (c)	USD/100 kg	279	189	239	255	159	205	218	164	238	256
CHEESE											
OECD (b)											
Production	kt pw	15 013	15 624	16 864	17 932	15 462	16 552	17 581	15 475	16 768	17 909
Consumption	kt pw	14 459	15 013	16 238	17 315	14 861	15 984	17 029	14 874	16 158	17 297
Stock changes	kt pw	15	1	7	6	1	7	6	1	7	6
Non-OECD											
Production	kt pw	4 629	5 014	5 473	5 897	4 984	5 407	5 828	4 983	5 446	5 897
Consumption	kt pw	4 954	5 412	5 881	6 296	5 373	5 757	6 162	5 372	5 837	6 291
WORLD											
Production	kt pw	19 642	20 638	22 337	23 828	20 446	21 959	23 409	20 458	22 214	23 806
Consumption	kt pw	19 414	20 425	22 119	23 611	20 234	21 740	23 192	20 246	21 995	23 588
Stock changes	kt pw	18	1	7	6	1	7	6	1	7	6
Price (d)	USD/100 kg	379	262	300	318	243	284	302	246	300	318

a) Year ending 30 June for Australia and 31 May for New Zealand in OECD aggregate. b) Excludes Iceland but includes the 8 EU members that are not members of the OECD. c) f.o.b. export price, butter, 82% butterfat, Oceania. d) f.o.b. export price, cheddar cheese, 39% moisture, Oceania.

est.: estimate.

Source : OECD and FAO Secretariats

Calendar year (a)	Average 2006-08est.	Base Average			Lower GDP-slow recovery Average			Lower GDP-faster recovery Average			
		2009-11	2012-2017	2018	2009-11	2012-2017	2018	2009-11	2012-2017	2018	
SKIM MILK POWDER											
OECD (b)											
Production	kt pw	2 539	2 584	2 618	2 673	2 576	2 588	2 641	2 578	2 609	2 672
Consumption	kt pw	1 663	1 821	1 845	1 841	1 829	1 845	1 841	1 827	1 841	1 840
Stock changes	kt pw	38	-2	-20	-2	-2	-20	-2	-2	-20	-2
Non-OECD											
Production	kt pw	755	847	963	1 054	842	956	1 044	842	961	1 053
Consumption	kt pw	1 439	1 573	1 718	1 849	1 552	1 680	1 809	1 555	1 710	1 849
WORLD											
Production	kt pw	3 294	3 432	3 582	3 727	3 418	3 544	3 686	3 419	3 570	3 725
Consumption	kt pw	3 101	3 394	3 563	3 691	3 381	3 525	3 649	3 382	3 551	3 688
Stock changes	kt pw	38	-2	-20	-2	-2	-20	-2	-2	-20	-2
Price (c)	USD/100 kg	329	201	249	257	193	242	250	194	248	257
WHOLE MILK POWDER											
OECD (b)											
Production	kt pw	1 881	1 956	2 059	2 153	1 950	2 040	2 134	1 950	2 048	2 149
Consumption	kt pw	785	781	786	791	779	782	786	779	784	790
Non-OECD											
Production	kt pw	2 274	2 582	2 973	3 284	2 571	2 944	3 250	2 572	2 964	3 284
Consumption	kt pw	3 230	3 618	4 107	4 507	3 603	4 063	4 459	3 603	4 089	4 503
WORLD											
Production	kt pw	4 156	4 538	5 032	5 437	4 521	4 984	5 384	4 522	5 012	5 433
Consumption	kt pw	4 016	4 399	4 893	5 298	4 382	4 846	5 245	4 383	4 873	5 294
Price (d)	USD/100 kg	342	202	254	269	193	246	260	194	254	269
WHEY POWDER											
Non-OECD											
Wholesale price, USA (e)	USD/100 kg	87	53	59	63	50	56	59	51	59	63
CASEIN											
Price (f)	USD/100 kg	658	423	517	526	416	524	537	418	523	530

a) Year ending 30 June for Australia and 31 May for New Zealand in OECD aggregate. b) Excludes Iceland but includes the 8 EU members that are not members of the OECD. c) f.o.b. export price, non-fat dry milk, 1.25% butterfat, Oceania. d) f.o.b. export price, WMP 26% butterfat, Oceania. e) Edible dry whey, Wisconsin, plant. f) Export price, New Zealand.

est.: estimate.

Source : OECD and FAO Secretariats

OECD-FAO Agricultural Outlook 2009-2018

This is the fifteenth edition of the *Agricultural Outlook* and the fifth time it has been prepared jointly by the Organisation for Economic Cooperation and Development (OECD) and the Food and Agriculture Organization of the United Nations (FAO). This edition covers the outlook for commodity markets during the 2009 to 2018 period, and brings together the commodity, policy and country expertise of both organisations. The report analyses world market trends for the main agricultural products, as well as biofuels. It provides an assessment of agricultural market prospects for production, consumption, trade, stocks and prices of the included commodities.

Looking forward, real commodity prices over the 2009-18 period are projected to remain at, or above the 1997-2006 average, the period just before the recent price hikes. An expected economic recovery, renewed food demand growth from developing countries and the emerging biofuel markets are the key drivers underpinning agricultural commodity prices and markets over the medium term. The projections and past trends are presented in the statistical annex, and can be viewed in more detail at the website www.agri-outlook.org.

This edition of the *Outlook* was prepared in a period of unprecedented financial market turmoil and rapidly deteriorating global economic prospects. Because macroeconomic conditions are changing so quickly, this report complements the standard baseline projections with an analysis of revised short-term GDP prospects and alternative GDP recovery paths. Lower GDP scenarios result in lower commodity prices, with reductions in crop and biofuel prices about one-half those for livestock products. A sensitivity analysis to highly uncertain crude oil prices shows the important links between energy and agricultural prices. The *Outlook* also reports on a survey of various actors in the agri-food chain in terms of the current impacts of the global economic crisis and credit market constraints. The issue of food security and the capacity of the agricultural sector to meet the rising demand for food remains very high on the international political agenda. This report provides a brief overview of critical factors such as land availability, productivity gains, water usage and climate change, and suggests that agricultural production could be significantly increased, provided there is sufficient investment in research, infrastructure and technological change, particularly in developing countries.