# The surprising fall in oil prices since mid-2014

## What does it mean for food and agriculture?

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Key messages

- **Oil prices have fallen** since mid-2014 from more **US$100** to **US$50–60** a barrel
- **Lower oil prices reduce costs of machinery operation, fertiliser and transport in farming**. Cereals prices are expected to fall by 10–14% on international markets, reinforcing the new norm of lower and more stable cereals prices.
- **Lower oil prices make biofuels** from low-yield feedstock, such as jatropha, **uneconomic**. Sugar cane ethanol and biodiesel from oil palm remain profitable. US ethanol production will be unaffected, owing to mandated production.
- **All this is good news for both farmers and consumers**. A danger exists, however, of political complacency if governments cut spending on research and other public goods that underpin rising agricultural productivity.

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# Acknowledgments

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# 1 Background: the surprising fall in oil prices

## 1.1 Oil prices down by half since the middle of 2014

Crude oil prices have historically fluctuated. In the 35 years since 1980 prices ranged from a low of less than US$14 a barrel to a high of more than US$130 a barrel, in constant 2010 dollars, see Figure 1.

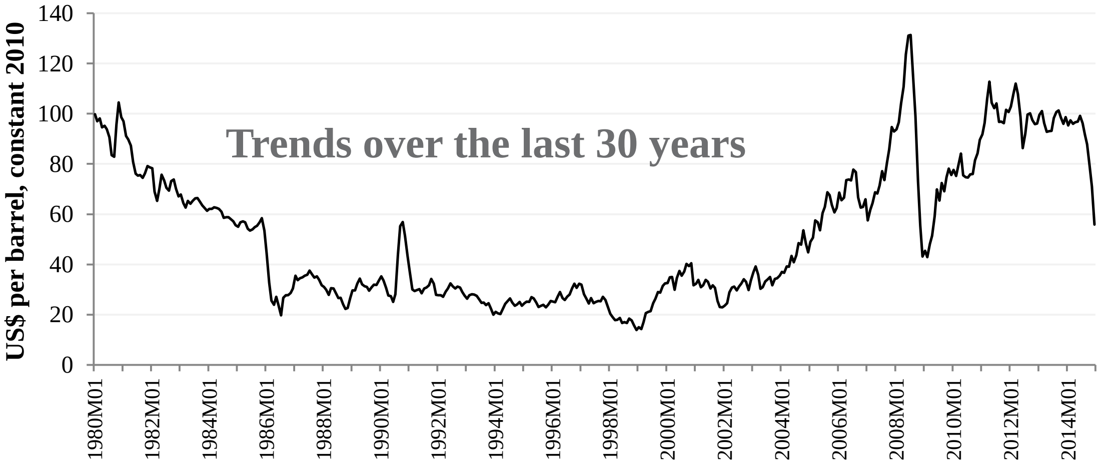
From 1980 to 1999 oil prices fell from around US$100 a barrel to less than US$14 a barrel. Investment in technologies to obtain oil from offshore fields made when prices were high in the early 1980s led to abundant supply of oil that pushed prices down. That however led to under-investment in exploration and development of new oil fields, so that increases in supply slowed.

As growth of demand outstripped growth of supply, oil prices rose after 2002, spiking in early 2008 at over US$130 a barrel, then slumped back in late 2008 and 2009, before rising again to settle at around US$100 a barrel from early 2011. From then until the middle of 2014 it seemed that US$100 a barrel was a norm: most projections made during this period predicted prices close to this level for the next five to ten years.

Subsequently, to the surprise of most observers, spot prices for oil have fallen dramatically since the second half of 2014, to around their former level and even dropping below US$50 a barrel, see Figure 1.

### Figure 1: Crude oil price, January 1980 to January 2015

(a) *Jan 1980 to Dec 2014, monthly: Real*



(b) *Jan 02 2014 to Jan 05 2015, daily: Nominal*


*Source: Monthly oil price from IMF: Crude Oil (petroleum), simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh; deflated by CPI from OECD.Stat. Daily oil price (RHS) from US EIA: Cushing, OK WTI Spot Price FOB (Dollars per Barrel)*

*Note: CPI value for Dec 2014 was not available: Nov 2014 value was used.*

## 1.2 What is driving the fall?

"... it is the combination of slow growth in demand and the rapid growth in supply that has led to the current plunge in oil and gasoline prices"

Wally Tyner, quoted in Purdue (2014)

On the ***supply side…***

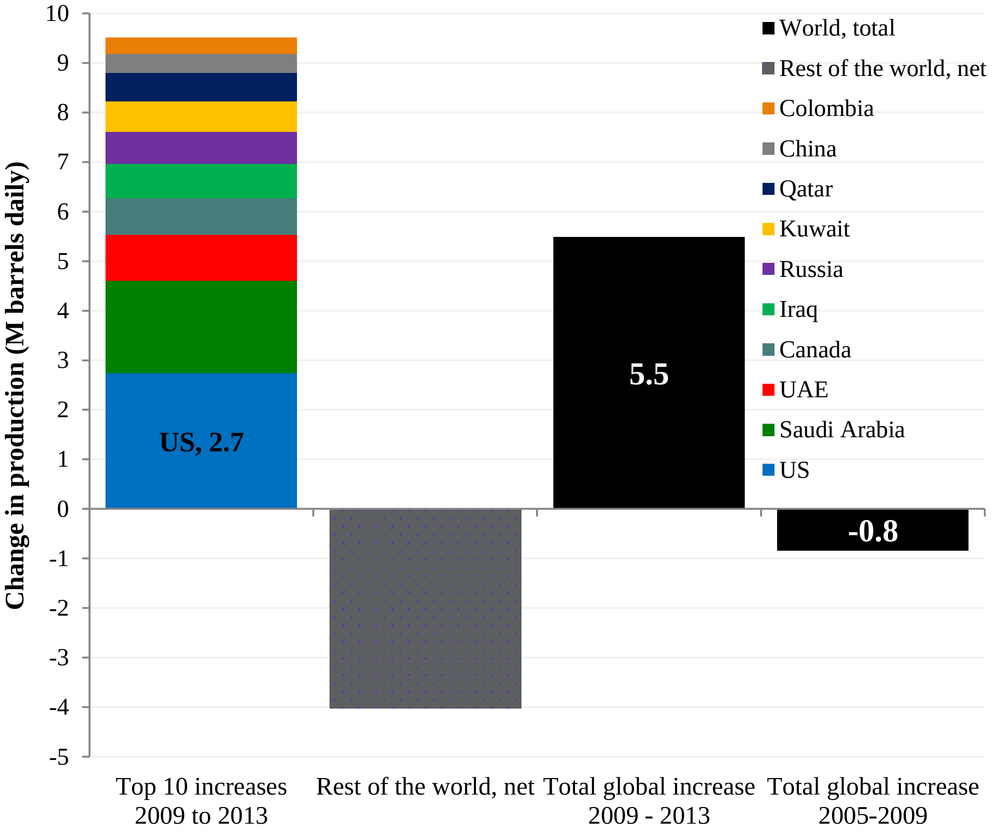
For the past six years since the spike of 2008 many in industry have assumed oil will be worth US$100 a barrel for the foreseeable future. Billions of dollars have been poured into oil exploration and expansion over this period. Exxon, Chevron, BP, and Petrobras, for instance, spent some US$110 billion on acquisition, exploration and development in 2013, compared to US$67 billion in 2009 — a whopping 64% increase (Forbes, 2014). [1]

Output has ***boomed***

The result of all this extra spending and activity is that global oil supply has grown strongly since 2009. Globally, production increased by 5.5M barrels a day from 2009 to 2013, against a total of 89M barrels a day (2011, IEA); compared to a fall of almost 1M barrels a day in the previous five years from 2005 to 2009. Much of the increased production has come from North America, especially from the US that increased supply by 2.7M barrels a day owing largely to fracking and horizontal drilling. Other large increases have come from the Middle East, as well as Russia, China, and Colombia, see Figure 2.

[1] Finding and development costs for major oil and gas companies have increased from under $10 to over $20 per barrel of oil equivalent over the decade to 2014 (Evaluate Energy, cited in Forbes, 2014) These costs are presumably acceptable when oil is worth US$100 a barrel, but perhaps less so when prices are at half that level. [To the costs of finding and development can be added those for extraction.]

## Figure 2: Crude oil production changes:




***Source**: Data from BP Statistical Review of world energy 2014 workbook.*

OPEC refrain from cutting back

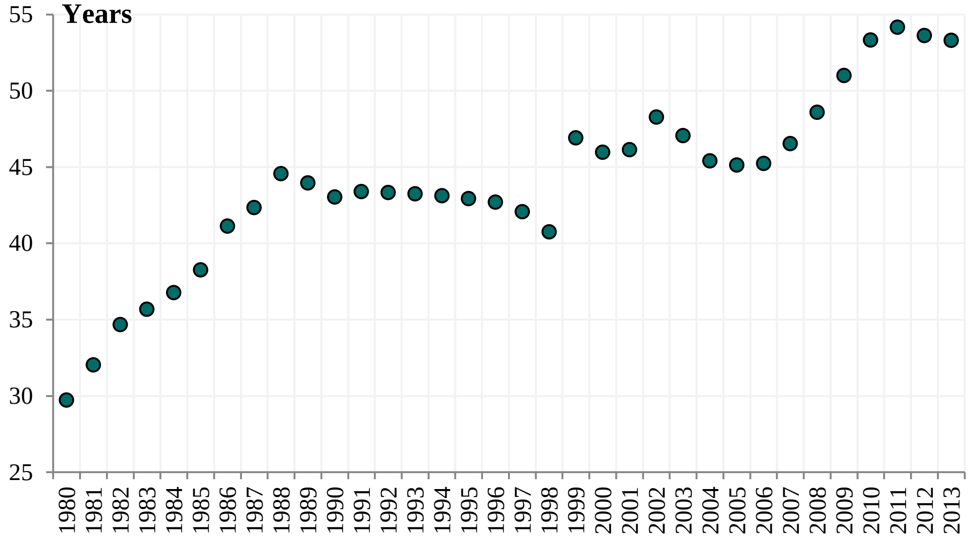
Despite falling prices, in late November 2014 OPEC countries decided to continue producing at the same rate, rather the cutting supply (Williams, 2014). This is in contrast to their position in 2008/09, when deep production cuts were made to prevent prices from further declining[2].

With plenty ***more in reserve***

Known reserves too have grown; with the largest increases from 2009 to 2013 seen for Venezuela (87.2 billion [G] barrels), Iraq (35G), Iran (20G) the US (13.3G) and Russia (4.7G). Net increases in known reserves have outpaced increases in production so that the global ***reserves to production ratio*** — a measure of how many years it would take to run known reserves down to zero at current production — has reached 50 or more. The world is thus far richer in oil now than thirty years ago, when known reserves were worth only 30 years' production: see Figure 3.

[2] Keane et al., (2015) summarise how this move by OPEC has been variously interpreted: as strategic (driving higher-cost producers – such as US frackers – out of the market) to maintain market share [Hume, 2015]; potentially a response to being caught off guard (Pugh, 2015); or a deliberate decision to maintain production and prevent non-OPEC producers from benefiting as in the past from a decline in OPEC output.

## Figure 3: Oil reserves to production ratio: 1980 to 2013




***Source**: Constructed with data from BP Statistical Review of world energy 2014 workbook.*

On the ***demand side…***

Increasing supply is only part of the story: two-fifths of the decline in oil prices in the second half of 2014 are thought to result from weak global demand (Keane et al. 2015 citing Hamilton 2014). Demand for oil has grown weakly in recent years, as economic growth for many regions of the world has been low – as in the case of Europe and Japan, or slower than normal – as in the cases of China and India – and even negative, as in the case of Russia (Purdue, 2014)

Inelastic demand and supply make for big price shifts

The sudden and surprising fall in oil prices owes much to the relatively inelastic supply and demand in the short run in oil markets. Quite small shifts in demand and supply can then lead to sharp movements in prices.

## 1.3 How long will the fall last?

While it is notoriously difficult to predict short-term moves in oil prices with any accuracy, oil prices look unlikely to return to a US$100 a barrel within the next few years. Production will probably not fall back much in the short run, despite the lower prices, because the big investments in exploration and development of oil fields have already taken place.

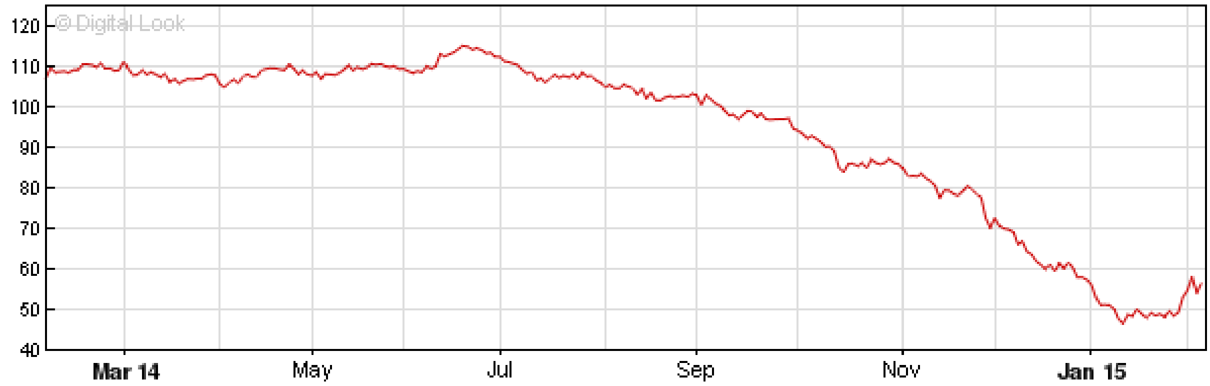
The emergence of fracked shale oil as a significant source of oil complicates projections. Unlike conventional oil wells where oil may flow for years once the well has been installed, much of fracked oil flows within a few years of drilling, so that to sustain production new wells have to be drilled. This makes shake oil more responsive to prices. On the other hand, governments may encourage shale oil for strategic reasons, as may apply in China (explored in Hou et al., 2014).[3]

***Recent oil price projections for 2016 range from US$30 to US$60 per barrel, while for 2020 they fan out across a wider range between US$40 and US$100*.** (Pugh et al., 2015, in Keane et al.,

[3] Operating costs of shale oil are estimated to be around ten to twenty dollars a barrel, while new shale projects are estimated to cost between fifty and eighty dollars a barrel [Pugh (2015), as described in Keane et al., 2015]. Hence in the short run prices below US$50 a barrel do not deter production, but in the longer term they deter further exploration and development.

2015). Latest futures prices for Brent Crude have been in the US$45 to US$60 range from January 2015, see Figure 4.

### Figure 4: Oil futures, year to February 6 2015, US$ per barrel




*Source: BBC Market data*

While some fear that sustained lower oil prices might reduce investment and development of ***alternative renewable energy***, others suggest these fears are overplayed. Indeed it may be that oil will soon be an 'alternative' or marginal energy source: welcome news if it comes to pass, see more detail in Box A.

### BOX A: The Economist's energy panacea. Five reasons why energy may be abundant within a decade or two at modest prices

*The Economist* (Lucas 2015) recently argued that, no matter the current cost of oil, improvements in efficiency and technology could lead to cheap and abundant energy within the next two decades.

1. **Solar power** will become abundant. Costs of fossil fuels fluctuates, but that of solar is falling. Solar photo-voltaic panels become ever cheaper, while solar film could reduce unit costs still further and improve energy capture;
2. **Electricity storage** is becoming cheaper and more common — batteries, water and ice. Inter-connectors may be useful to balance electricity across grids, but increased small-scale storage may be even more telling;
3. **Decentralised distribution** with fuel cells as local power units is growing. Not only does this promise to allow use of wastes to generate power, but also offers to reduce energy costs dramatically in areas off grid, such as much of rural Africa;
4. **Information technology** can help save power. Combined with advances in energy efficiency — above all of heating buildings — this promises to largely uncouple energy demand from economic growth. Unit costs of saving energy are lower than the generation costs of most additional energy; and,
5. **Finance** is entering production of renewables and efficient use of energy as never before, especially since proven models exist, in response to public mandates and the looming need to reduce emissions.

**"The story may be not so much what falling oil prices mean for clean energy than what the prospect of clean energy will mean for the oil price."**

*Source: Lucas, Edward, 2015, Energy & technology.* ***Special Report****, The Economist, 17 January 2015*

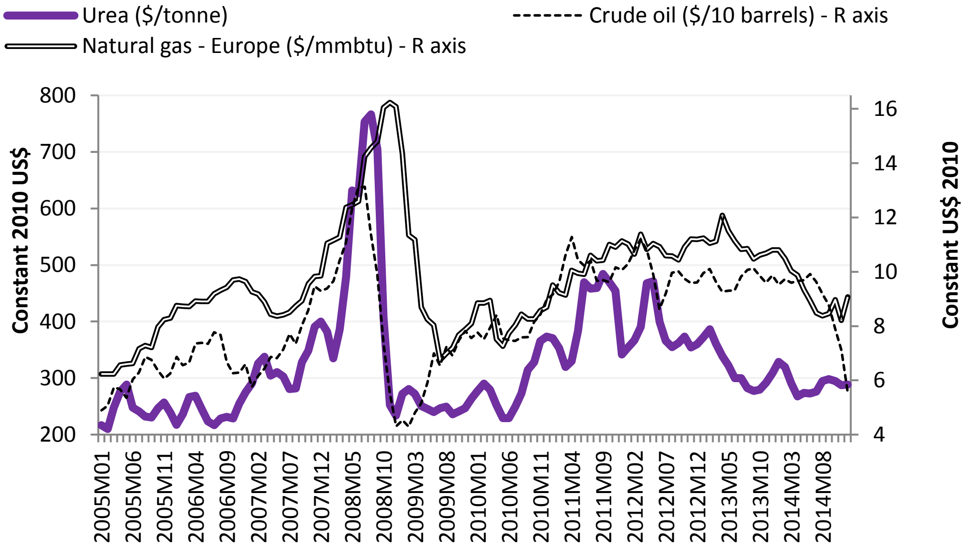
# 2 How oil prices affect food prices, agriculture and food security

Lower oil prices should reduce food prices to consumers by lowering production and transport costs. As the food supply curve shifts to the right, output expands, reducing the cost of food and — since demand for food is typically inelastic — yielding major increases in consumer surplus, together with lesser increases of producer surplus.

***Production costs***

With lower fuel costs, farm vehicles and other machinery will be less costly to run, water cheaper to pump. Fertilizer costs should decline since urea and other nitrogenous fertiliser is produced from natural gas whose price is closely related to that of oil, see Figure 5. Urea prices started falling before those of oil, more in line with trends in natural gas prices, with the nominal price of urea going from around US$400/tonne in early 2013 to around US$312/tonne in Dec 2014: a decline of around 22%.

### Figure 5: Urea, crude oil and natural gas prices: January 2005 to December 2014




*Source: Oil price from IMF: Crude Oil (petroleum), simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh. Urea and natural gas prices from World Bank 'Pink sheet'. Prices deflated by CPI from OECD.Stat.*

Example: ***rice production costs in China***

Production cost savings generated from these fertiliser price declines are likely to be modest, but not insignificant. For example, a 30% fall in chemical fertiliser cost would reduce variable costs for rice production in China by about 5% on average.[4]

[4] Calculated from average rice production cost data for China for 2010, from Prof. Jikun Huang.

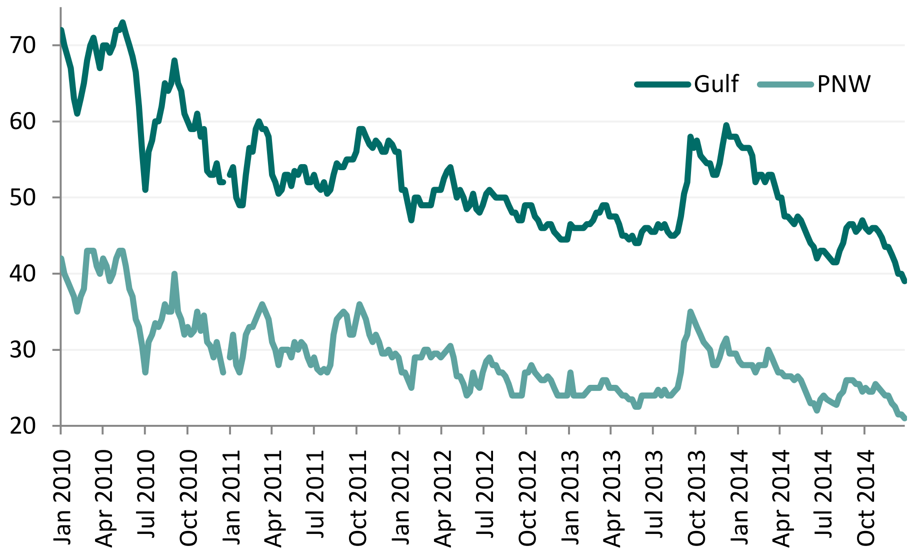
That is not to say that lower fertiliser costs will mean lower spending on fertilizer. It may instead spur producers, particularly those who begin from a low base of input use, to apply more fertiliser, raising yields and reducing unit costs.

***Transport costs***

Lower transport costs should reduce input costs and increase produce prices at the farm-gate. This applies all the more for crops that are traded over long distances. Reduced freight costs can be seen in ocean rates charged for shipping grain, for example from the US to Japan, via either the Gulf of Mexico or the Pacific Northwest (PNW), see Figure 6.

Rates had been falling since (at least) early 2010. From June 2014 to Dec 2014 these prices fell on average about 7% (Gulf) and 5% (PNW): small declines considering the oil price fell some 44% over this period.

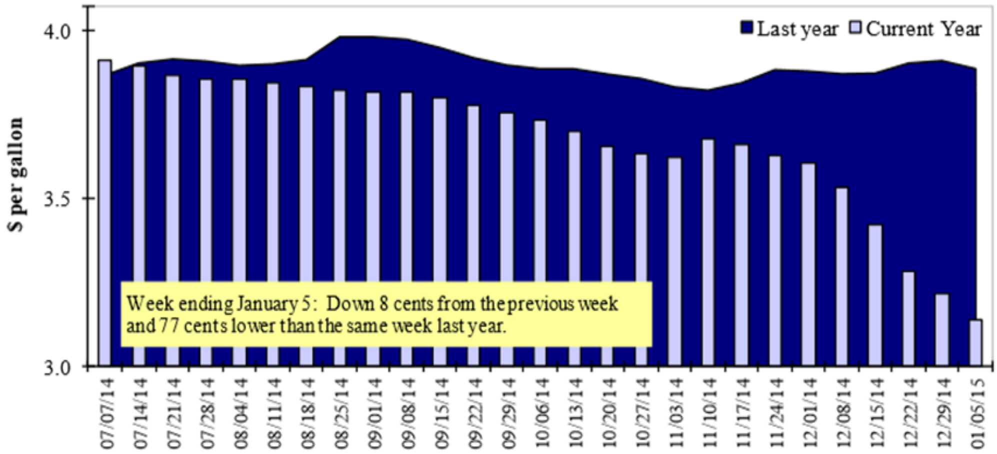
### Figure 6: Ocean freight rates, grain from US East and West coasts to Japan, Jan 2010 to Jan 2015




*Source: USDA T&M Grain Transport Cost Index Calculations*

Ocean rates may not be as closely correlated with oil prices as other transport costs, since much depends on demand for shipping and hence the capacity that is spare. ***Road freight costs*** relate more closely to fuel prices. In the US diesel fuel prices fell some 15 cents per litre in the six months from mid-2014; with a fall of around 20% over the year from the first week of January 2014 to the first week of January 2015. Since diesel makes up around 30% of the cost of trucking, this would imply a 7% reduction in rates.

## Figure 7: Diesel fuel prices, US average, July 2014 to January 2015, compared to July 2013 to January 2014




***Source**: Figure 13 from USDA Agricultural Marketing Service. . http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5110138.* ***Original source**: Retail On-Highway Diesel Prices from the Energy Information Administration, US Department of Energy.*

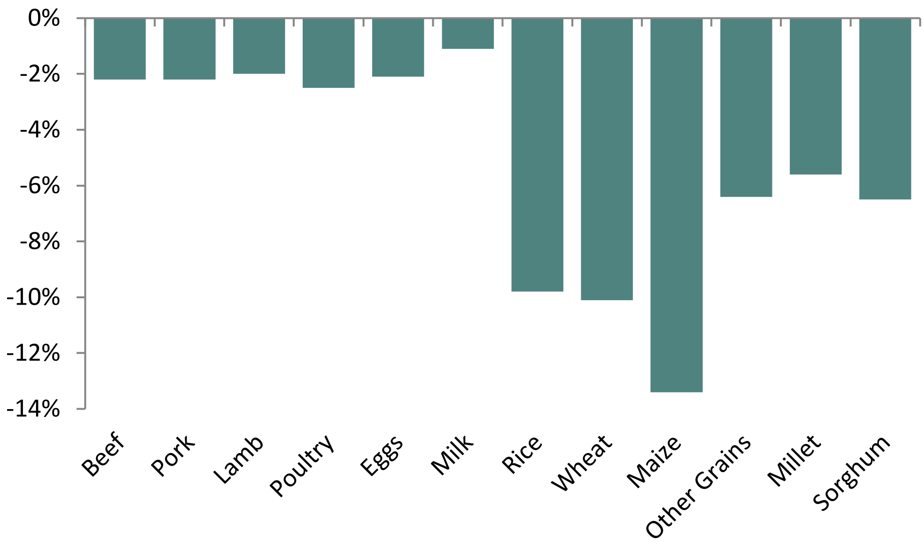
Overall: ***yields up, prices down, less hunger and malnutrition***

It's easy to see how lower oil prices should cut costs on farms and in supply chains. But just how much might this stimulate production and push down prices on markets? A model can capture most of the significant factors and their interactions. IFPRI's IMPACT model covers 46 major crops and livestock products across 115 countries and regions to estimate demand, supply, trade, prices and impacts on food and nutrition security.

IMPACT was run in 2011 to examine the likely evolution of the world food economy through to 2050. In one scenario, oil prices were doubled (Rosegrant et al. 2012). Given the logic of the model, the changes resulting from this would be the exact inverse if oil prices were to halve, as they have since mid-2014. So, turning the scenario on its head, what does IMPACT predict when oil prices halve?

- ***Grain yields per hectare would rise***, by between 2.1% for millet and 4.7% for rice.
- ***Prices on world markets would fall.*** The major grains of maize, rice and wheat would see falls of 10–14%, while those for livestock products would fall by around 2%, see Figure 8.

**Figure 8: Lower prices on world markets from halving of oil prices**




*Source: Table 5, Rosegrant et al. 2012, with price effects inverted*

- ***Fewer people hungry and malnourished.*** The model predicts a fall of 4% in the numbers of children stunted, and a 14% reduction in the numbers of people undernourished — most of them in the developing world.

# 3 Biofuels

Given the huge impact of biofuels on cereal demand and prices over the last decade — particularly use of maize for ethanol in the US — what will be the impact of lower oil prices on biofuel production? Biofuel production responds in part to market prices for ethanol and biodiesel that are linked to petroleum and diesel prices which are derived from oil prices. All these links are moderated by policy, including mandated production and use of renewable fuels, as well as taxes and subsidies on petrol and diesel prices.

## 3.1 Biofuel economics in the developing world

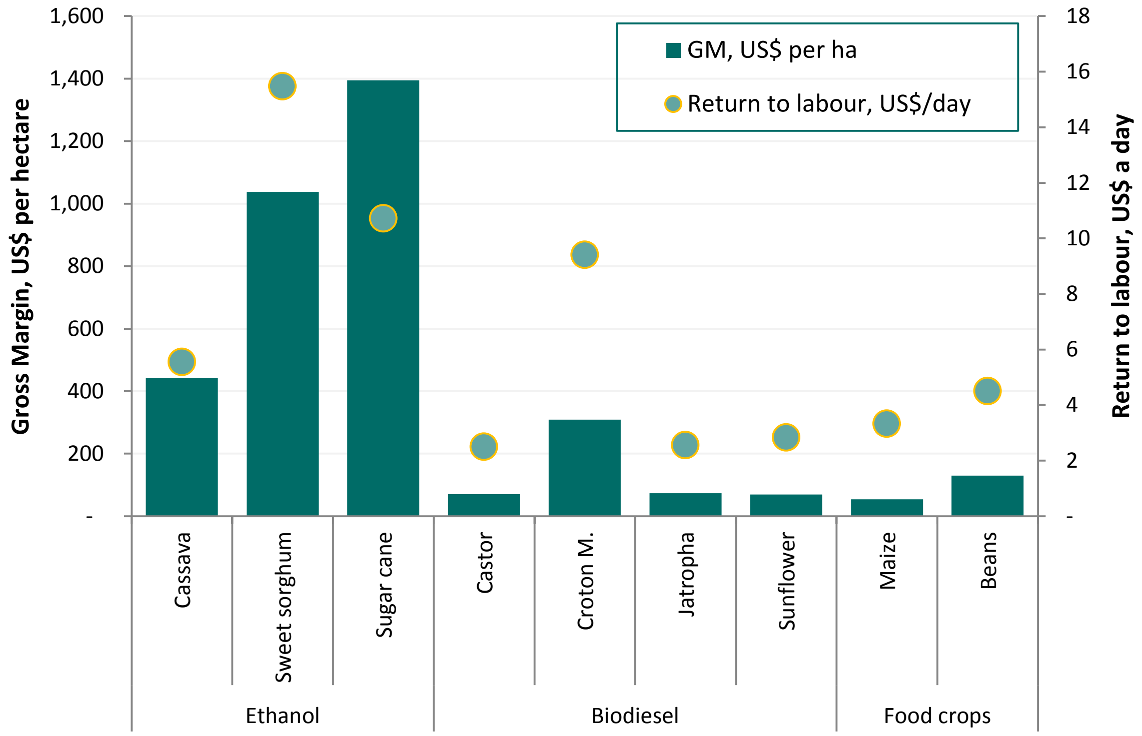
Lower oil prices alter the underlying economics of growing biofuel feedstock. Take the case of Kenya. At oil prices of US$110 a barrel, a range of crops would generate reasonable returns to land and labour if grown to produce biofuel: cassava, sweet sorghum, sugar cane and croton all generate more than can be earned from planting land to maize or beans, see Figure 9a.[5] But at US$60 a barrel of oil returns to feedstock drop sharply (Figure 9b). Only sweet sorghum and sugar cane remain viable: other crops would not cover their costs.

[5] Oil prices have been translated to petrol and diesel prices, which then mark the price ruling for ethanol and biodiesel — adjusted for energy content; from which prices for feedstock can be derived after allowing for processing and transport costs.

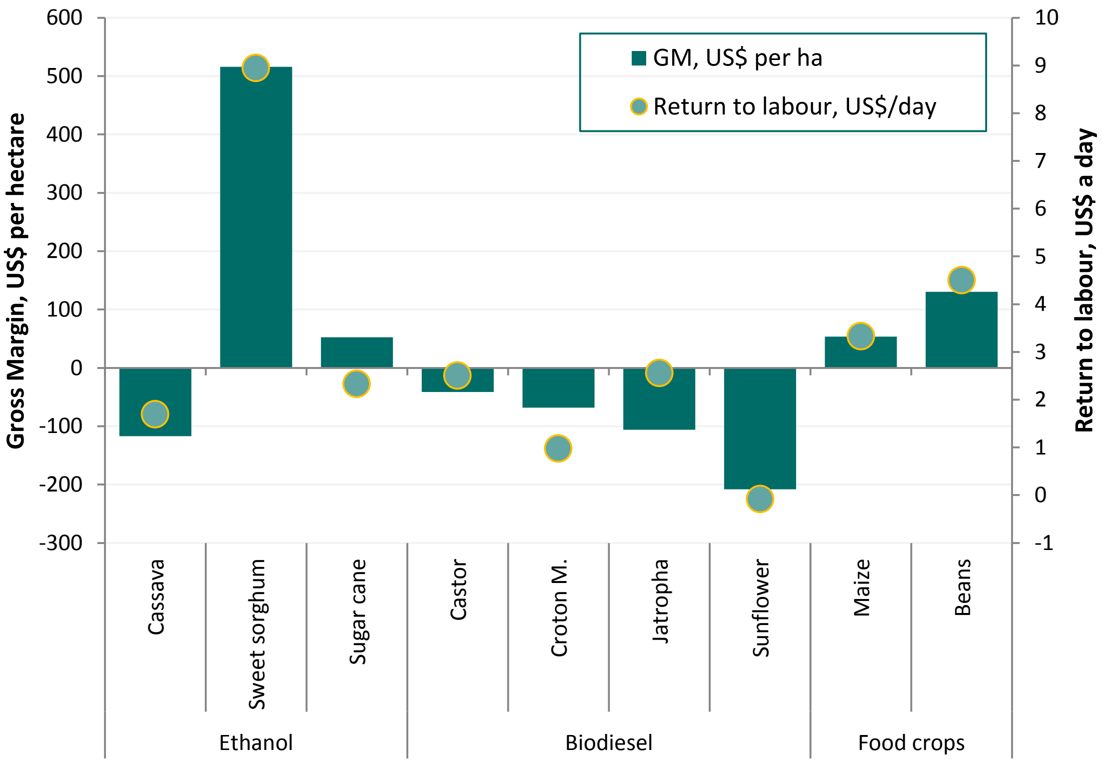
## Figure 9: Returns to potential biofuel feedstock, Kenya, 2011

Maize and beans included to show food crops returns

(a) If oil prices were US$110 a barrel



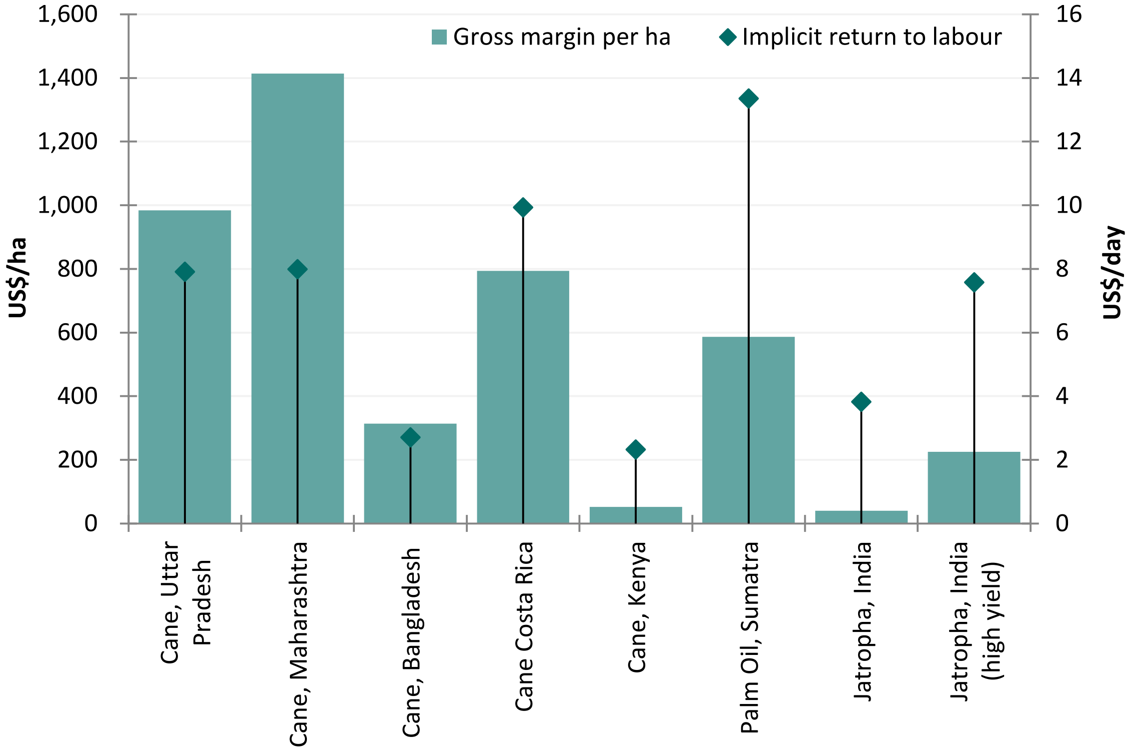

(b) If oil prices were US$60 a barrel




*Source: Described in Wiggins et al. 2011*

Similar results can be seen for feedstock grown in other countries, see Figure 10. While returns to oil palm and to sugar cane grown at low cost, as in Costa Rica and India, remain attractive, those for jatropha and more costly cane become marginal.

### Figure 10: Returns to biofuel feedstock, 2014, at oil price of US$60 a barrel




*Source: Various, see Wiggins et al. 2008. Costs of production updated to 2014*

***In sum,*** lower oil prices mean that producing biofuel from some feedstocks that are marginal — owing to high costs of production or low yield — becomes unprofitable: but biofuel from sugar cane and oil palm remains attractive, even if less profitable than when oil prices were higher. The case for biofuels in developing countries that have especially high costs for imported petroleum owing to their landlocking — think Zambia, for example — remains strong. Moreover, for areas suitable for cane and oil palm — those with relatively high rainfall or irrigation — highly-productive technologies are known and proven.

Lower oil prices, however, should put paid to the over-enthusiasm for much-vaunted crops such as jatropha once and for all.

## 3.2 Biofuels in the US

Ethanol prices in the US have fallen since mid-2014. Over the last five years, ethanol prices in a leading producer state, Iowa, have been from US$2.00– 2.40 a gallon. By late February 2015 they were US$1.25–1.35 a gallon, a 40% fall[6]. Presumably with falling gas prices in the US, blenders are prepared to pay less for ethanol as a substitute.

[6] USDA web site, http://www.ams.usda.gov/mnreports/lswagenergy.pdf, accessed 2 March 2015

Does this mean, then, that ethanol distillers have cut production and hence reduced their demand for maize as a feedstock? Apparently not. Between mid-2014 and November 2014, the latest month for which data exist, there was no reduction in ethanol production[7].

Three factors explain this surprising fact. One, the renewable fuel mandates have not changed: for 2015, 15 billion gallons of renewable fuels have to be produced. Two, ethanol distillers have installed capacity: they may continue to distil even when the ethanol price falls since marginal revenue may well exceed marginal cost. It helps that some plants did so well during the 'Ethanol Gold Rush' (Abbott 2013) from mid-2005 to mid-2007 that they quickly paid off their capital costs. Three, marginal costs have fallen since the cost of feedstock, maize, has come down: currently futures prices for harvest time 2015 are around US$4 a bushel, compared to more than US$5 a bushel in May 2014. Moreover, falling costs of US gasoline have led to higher demand for gas, and hence for ethanol as an oxygenate.

Hence the lower oil price has not affected US demand for maize to distil to ethanol, nor is it likely to.

# 4 Concluding comments

Lower oil prices will push down food prices. It confirms and underpins the analysis from April 2014 — see the Annual Review — that argued that a new norm has been reached in cereals markets, with lower prices and less volatility than has been seen since 2007. That norm should see prices 10 to 15% lower than would otherwise be expected.

In many respects, lower oil prices are an unalloyed boon to agriculture, food systems and consumers. Food prices should fall. Moreover, lower oil costs should have wider benefits to economies. Expanded farm output from reduced oil and fertiliser costs should stimulate the rural non-farm economy (RNFE) through multipliers. At national level, lower food costs will save foreign exchange for food importers. Exporters of food are likely to see more demand for their output.

For all these reasons, lower oil prices are good news. But lower prices for agricultural produce are not an unalloyed blessing. In theory lower costs of production mean that farmers should not mind lower prices: their producer surplus should if anything increase, not fall — even if the big winners will be consumers.[8] In practice, however, some farmers may be deceived by lower output prices and invest less for the longer run, believing that the returns will no longer justify the cost. Those farmers who, however, factor in lower production costs should see that their margins have not fallen.

But the greater danger lies not with farmers, but with governments. When in 1973/74 and 2007/08 prices spiked on world markets the shock to leaders was severe, provoking redoubled investment in agricultural research, extension, rural roads, irrigation and drainage — supported by policies to stimulate farming. When, however, prices fall back so that leaders can comfortably forget about agriculture, the result seen from the early 1980s onwards was neglect of the longer-term public

[7] US Energy Information Administration, Monthly Energy Review, February 2015, http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf

[8] Most agricultural markets have inelastic demand and relatively elastic supply. When production costs fall, the supply curve shifts down and to the right, so that the amount produced rises and prices fall. Consumer surplus increases strongly, while producer surplus will increase by a much smaller amount.

investments that fuel productivity improvements and maintain downward pressure on prices. Political complacency is the danger with the emerging new norm of lower prices.

This is not to call for heavy public investment in agriculture under all circumstances. Rather it is to say that wise governments will continue to fund agricultural research, extension and other rural public goods such as roads to a level sufficient to keep the rural economy growing and prospering. Large sums are not necessarily implied: reinvesting 2% of agricultural gross product in research and extension — roughly what OECD countries spend[9] — should be sufficient to generate the technical advances needed to realise productivity gains.

[9] Most developing countries spend much less than 2%: often half this level.

# References

Abbott, Phil, 2013, ‘Biofuels, binding constraints and agricultural commodity price volatility’, NBER Working Paper 18873, http://www.nber.org/papers/w18873

EIA, (accessed 2015). Egypt: Overview/Data. US Energy Information Administration. http://www.eia.gov/countries/country-data.cfm?fips=EG

Forbes, Aug 29 2014. Q2 2014 Integrated Oil and Gas Round-Up: Capital Expenditures. http://www.forbes.com/sites/greatspeculations/2014/08/29/q2-2014-integrated-oil-and-gas-round-up-capital-expenditures/

Keane, J., Z. Hou, and J. Kennan, 2015. ODI (forthcoming)

Lucas, Edward, 2015, Energy & technology. **Special Report**, The Economist, 17 January 2015

Rosegrant, Mark W., Simla Tokgoz & Prapti Bhandary, 2012, ‘The new normal? A tighter global agricultural supply and demand relation and its implications for food security’, American Journal of Agricultural Economics, 95(2): 303–309; doi: 10.1093/ajae/aas041

Wiggins, Steve, Enrica Fioretti, Jodie Keane, Yasmeen Khwaja, Scott McDonald, Stephanie Levy & C S Srinivasan, 2008, Review of the indirect effects of biofuels: Economic benefits and food insecurity, Report to the Renewable Fuels Agency, 26 June 2008

Wiggins, Steve, Jodie Keane, Jane Kennan, Henri Leturque & Chris Stevens, 2011, Production, policy & trade opportunities for biofuels in Eastern Africa. **Research Report**. Bioenergy in Africa: opportunities and risks of jatropha and related crops. London: Overseas Development Institute

Williams, N., Nov 27, 2014. Oil prices dive after OPEC decides against output cut. Reuters. http://www.reuters.com/article/2014/11/27/markets-oil-idUSL3N0TH1DN20141127

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