The Impact of EU Biofuel Policy on Food Economics and Food Security to 2020

BioFuel Matters Ltd

Executive summary

Biofuels only marginal effect on cereal price increase

The grain price spike of 2007/08 was caused by cereal production falling behind the steadily growing demand of more than a decade. Grain prices were too low for too long from the 1990s to 2006 thus disincentivising an increase of production. External factors such as bad weather conditions, export bans and speculation aggravated the situation further.

In 2007/08 the world used about 3.4% of its total cereals production for bioethanol. Of this roughly 1% of the cereal is returned to the food chain as a protein-rich animal feed called DDGS. The net usage is 2.4% of global cereals production. Bioethanol in the EU in 2007/08 only accounted for for 0.06% of net global cereals production and 0.5% of net European cereals production with 42% of it being grown on set-aside land where food production was forbidden. EU bioethanol has had no discernible impact on the food price spike.

Last year's experience showed that bioethanol production was the first EU cereal processing sector to shut down due to high feedstock prices, whilst food processors were able to carry on. This demonstrated that there is a price cap beyond which bioethanol will not be produced.

Furthermore, in the case of an immediate food crisis the cereals designated for fuel purposes can always be freed for human consumption. That cereals are produced both for food and fuel provides a much greater food security and the possibility of contraining prices.

It is likely that the greatest impact of biofuels on the cereal markets has been the expectation of speculators that biofuels would become linked to oil prices and drag up the price of cereals. In fact, the opposite link is more likely to be have been the case, as the increasing cost of fossil fuel is driving up the cost of food.

Biofuels – a threefold opportunity for developing countries

Hunger is primarily a result of poverty. The EU biofuels policy can help to alleviate poverty in the developing world in three ways:

Firstly, 'excess' cereals production in the EU will be absorbed by the domestic bioethanol industry instead of being dumped on world markets. This will allow the domestic agriculture of developing countries to expand – without the permanent threat of subsidised EU grain mountains undercutting their market prices.

Secondly, most developing countries are importers of fossil energy (especially fuel) and spend a big chunk of their GDP on paying their energy bill and related products such as fertilisers. The EU biofuel policy reduces the cost of oil and thereby , the vicious cycle of fossil fuel related products and poverty..

Thirdly, in the case of developing countries with surplus land capacity for meeting their food requirements, the EU can contribute by aiding the country to develop its own sustainable biofuel industry that can also stimulate domestic agriculture and cut energy costs.

Broaden feedstock basis to allow further biofuels growth

One condition for the binding 10% 2020 target is the commercial availability of so-called 2nd generation biofuels. The political support of this development also has a positive impact on the discussion about food and fuel. By broadening the feedstock basis through the introduction of biofuel technologies that utilise ligno-cellulosic feedstocks the dependence upon cereal and sugar based feedstocks will be reduced. Waste streams from forestry and agriculture as well as dedicated energy crops can produce more biofuels on less land.

There is enough land in the European Union for food and biofuels

The EU population is declining resulting in static demand for consumption of cereals in the EU between now and 2020. At the same time productivity is expected to increase. These two structural developments will increase the availability of cereals without the need for more land.

Europe can meet its 10% renewable fuel target:

- without disrupting our domestic food production (or our exports),
- without any biofuel imports,
- without ploughing up one hectare of non arable land,
- and without depending on advanced biofuel production methods.

Abbreviations

AAP	Area Aid Payments
AIC	Agricultural Industries Confederation
BAP	Biofuels Assistance Package
CAP	Common Agricultural Policy
CBOT	Chicago Board of Trade
CEFS	European Sugar Manufacturers & Refiners Association
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Centre
CONCAWE	The oil companies' European association for environment, heath & safety in refining
DDGS	Dried Distillers Grains & Solubles
DG-AGRI	General Directorate for Agriculture
EBRD	European Bank for Reconstruction and Development
ESA	European Seeds Association
EEA	European Environment Agency
EU	European Union
EUCAR	European Council for Automotive Research & Development
FAS	Foreign Agricultural Service (USDA)
FAO	Food and Agriculture
FAPRI	Food and Agriculture Policy Research Institute
FEDIOL	EU Oil & Protein meal Industry Federation
FEFAC	European Feed Manufacturers' Federation
FOB	Free on board
FSU	Former Soviet Union
GDP	Gross Domestic Product
HGCA	Home Grown Cereal Authority
ITC	Information Technology & Communications
JRC	Joint Research Centre
LDC	Less Developed Country
LIFDC	Low Income Food Deficit Country
LIFFE	London International Financial Futures Exchange
MTR	Mid Term Review
NIR	Near Infra-Red
NREL	National Renewable Energy Laboratories
NVZ	Nitrate Vulnerable Zone
OECD	Organisation for Economic Co-operation & Development
RBOB	Reformulated Blendstock for Oxygenate Blending
SOC	Soil Organic Carbon
UNICA	Sao Paulo Sugarcane Agro-Industry Union
USDA	United States Department of Agriculture
WTO	World Trade Organisation

Units & Conversions

Bbl	Barrel = 42 US gallons = 159.2 litres or 7.4 bbl/t
Bu	Bushel (maize) = 25.4 kg or 39.37/tonne
ha	Hectare
Mha	Million Ha
MJ	Mega Joule
Mt	Million tonnes
Mtoe	Million tonnes oil equivalent = 41.868 GJ
t	tonne = 1,000 kg
US gal	United States Gallon = 3.79 litres

Bioethanol

1 cubic metre of bioethanol = 1 thousand litres by volume
263.85 US gallons by volume
0.794 tonnes by weight
22.8 GJ energy (lower heating value)
6.28 Barrels
0.5 tonnes of oil (energy equivalent)

1 tonne of bioethanol = 1.259 cubic metres to cubic meters
1,259 litres
332.2 US gallons
28.6 GJ energy (lower heating value)
7.91 Barrels
0.629 toe

1 Introduction

The EU biofuel policy is part of the overall Renewable Energy Policy formulated to contribute to climate change mitigation through the reduction of greenhouse gas emissions, sustainable development, security of supply and the development of knowledge based industry creating jobs, economic growth, competitiveness and regional and rural employment.

In January 2008 the European Commission put forward proposals for a Renewable Energy Directive to achieve a 20% target for renewable energy by 2020.[1] The package included a requirement that a minimum of 10% renewable energy sources are used in road transport by 2020.

The announcement of the new policy initiative coincided with the early stages of a surge in world grain prices that had started in the autumn of 2006.

Supply failures, rising demand and falling grain stocks drove up grain prices to unprecedented levels and drew in speculators who added further volatility to the market.

In this climate the proposed introduction of the EU 2020 10% minimum target triggered concerns that using cereals for biofuels will create food insecurity and significant food price inflation in Europe. Indeed some critics claim that current biofuel production has been a significant contributor to the food price spike of 2007 that led to civil unrest in some developing countries.

Furthermore it has been suggested that the impact of the EU biofuel policy will be to cause starvation in the developing world as well as creating social problems in low income countries where they may shift agricultural land from producing food crops to large scale biofuel feedstock production for the EU market.

"**Food security** exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern. **Food insecurity** exists when people do not have adequate physical, social or economic access to food as defined above. FAO – 2003 [3]

Europe is the world's third largest cereal producer[2] with a structural surplus that is exported. The exports tend to dampen world prices and restrain internal EU prices. In an oversupplied market the profitability of crop production in Europe and other parts of the world is undermined. Conversely, if Europe consumed more grain than it could produce it would then be competing to buy imports from the world market, raising world and EU prices, but creating a greater incentive for crop production in Europe and other areas of the world.

There are, potentially, important benefits for food security and long term prices that can result from a new market certainty that encourages agricultural investment to provide new infrastructure, develop new seed varieties and improve the application of agronomy within Europe. Biofuels may also provide opportunities for improved agricultural employment and food security in developing countries. In the longer term new technologies; agricultural, process and fuel utilisation, may further enhance biofuel capacity without any adverse impact of the food sector.

Therefore there is potential for positive and negative impacts on food security and prices by utilising EU cereal crops for bioethanol production to meet the proposed 2020 biofuels target.

The purpose of the study is to discuss these potential impacts. It will consider the impact of the EU biofuel policies on the economics of food production and food security[3] within Europe; the impact on poverty, which is cited as the main cause of hunger, in the developing world; and how new biofuel technologies may impact on these issues.

To improve the understanding of possible future biofuel developments a number of 2020 biofuel scenarios have been constructed. These describe some of the extreme possibilities such as; 100% imported biofuels and the maximum production from proven technologies using only EU feedstocks. The scenarios are then explored to assess their impact on food prices and food security.

The report is structured as follows – Chapter 2 considers if the current use of cereals for EU bioethanol has had an impact on domestic and international food prices and the resulting social unrest.

The constant and variable factors that will influence the development of European biofuels up to 2020 are considered in Chapter 3 and the potential outcomes used to construct a small number of 2020 EU biofuel scenarios.

In Chapter 4 the impacts of the 2020 scenarios on Europe's food prices and food security are analysed whereas Chapter 5 considers how the 2020 scenarios would impact on poverty, the main cause of food insecurity, in the developing world.

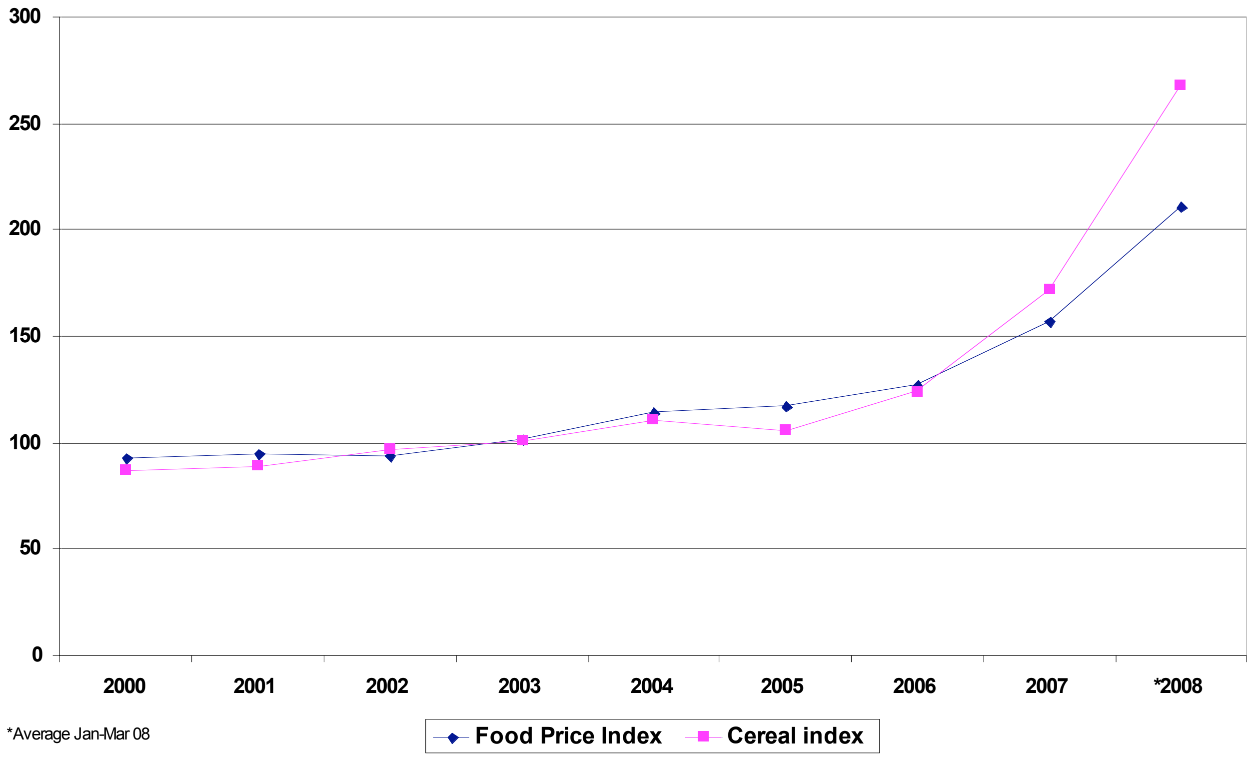
Chapter 6 considers the introduction of ligno-cellulosic processes for bioethanol production and how the broadening of the feedstock base to include crop residues and wastes will influence food prices and food security towards 2020.

Conclusions and recommendations are presented in Chapter 7 and further relevant analysis and statistics are included in the Annexes.

2 Bioethanol production & the 2007/08 food price spike

***London, 22 April 2008** - The World Food Programme (WFP) has said that high food prices are creating the biggest challenge that WFP has faced in its 45-year history, a silent tsunami threatening to plunge more than 100 million people on every continent into hunger. "This is the new face of hunger – the millions of people who were not in the urgent hunger category six months ago but now are," said WFP Executive Director Josette Sheeran 4*

The rise in world cereal prices since the autumn of 2006 has contributed to food price inflation and increased food insecurity for people in poverty. The FAO cereal price index rose from an average of 124 in 2006 to 268 for the first three months of 2008 – a rise of 116%. Prompting concerns about food price inflation in the developed world and the threat of hunger to people in developing nations who may not be able to buy sufficient food when prices are high.



In March 2008 the managers of the UN's World Food Programme estimated that the rising food prices would increase the cost of their food aid programmes by $775 million in 2008.[4]

The high grain prices have fed through the supply chain to have an impact on people in poverty and there have been many instances of civil unrest in the developing world. Protests have been against the prices of tortilla flour (made from white maize) in Mexico, pasta (made from Durum wheat) in Italy and there have been numerous protests about the price of rice and bread in Egypt, Bangladesh, Haiti, Philippines and other developing countries. [5]

Some observers have said that the biofuel policies of the US and EU were one of the main causes of the current worldwide food crisis[6].

GENEVA, Switzerland, April 28, 2008 (ENS) - The United States and the European Union have taken a "criminal path" by contributing to an explosive rise in global food prices through using food crops to produce biofuels, the United Nations special rapporteur on the right to food said today. At a press conference in Geneva, Jean Ziegler of Switzerland said that fuel policies pursued by the U.S. and the EU were one of the main causes of the current worldwide food crisis.6

This chapter discusses the reasons for rising cereal prices.

In particular, it assesses if there is any link between the use of cereals for European bioethanol production and rising cereal prices and the impact, if any, on food security.

2.1 So what has caused the price increases?

Grain prices are determined by the fluctuations in the balance of supply and demand. Sudden price changes, such as the 2007/08 price spike, occur when there is a market shock that unexpectedly increases demand or reduces supply. Stocks act to dampen the impact of supply failures but put downgrade pressure on prices because there is less supply risk.

Demand - World cereal demand has been rising steadily in line with increasing world population and the changing patterns of food consumption - especially increased consumption of protein foods in China that has been made possible by increasing wealth. There has also been increased cereal demand in countries with surplus cereals that are producing bioethanol to replace fossil fuels for road transport.

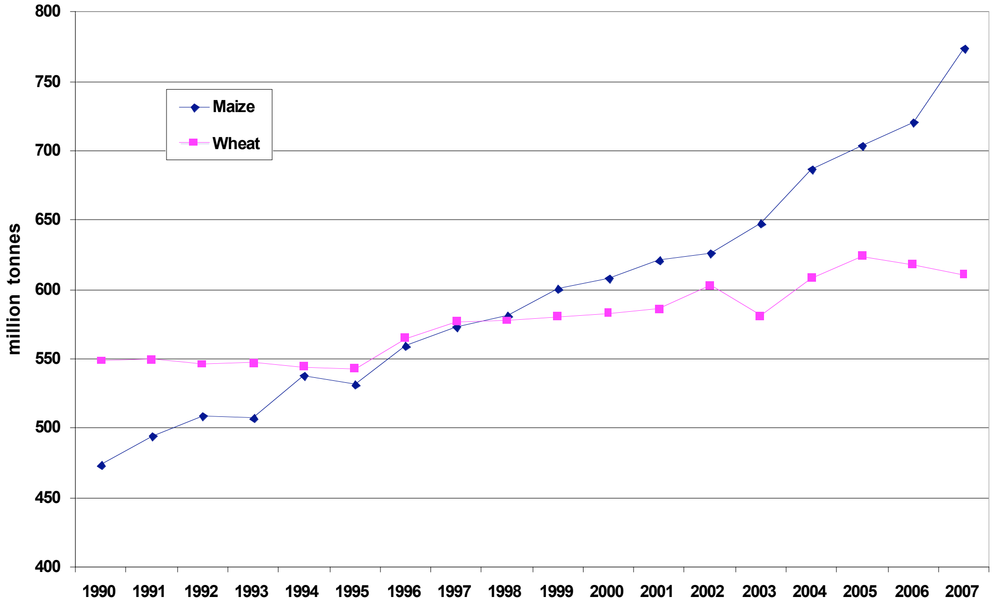


Figure 1: Growth in world maize and wheat demand

Figure 1 shows that since 1990 the demand trend for wheat has been rising at 4.8 Mt per annum and the trend for maize by 15.6Mt per annum. The constancy of this trend suggests that there has not been a demand shock that has caused the price spike.

Supply – Since 1990 world wheat production has been rising at the rate of 3.2 Mt per annum maize by 14.8 Mt per annum.

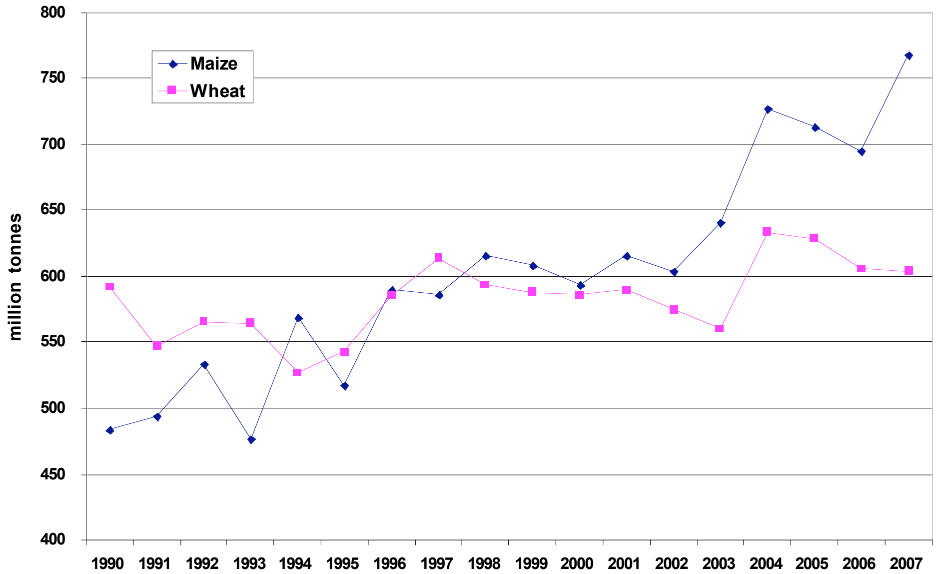


Figure 2: Growth in world maize and wheat supply[7]

Because of harvest fluctuations the supply in some years will exceed demand and at other times fall below demand. But since 1990, on average, production has been falling behind demand by 0.6 Mt per annum for maize and 1.6 Mt per annum for wheat.

Stocks

World wheat stocks fell by 96 Mt between 1999/00 and 2007/08 and over the same period maize stocks fell by 88 Mt. The annual closing stock levels are shown in Figure 3 along with the annual supply demand surpluses and deficits.

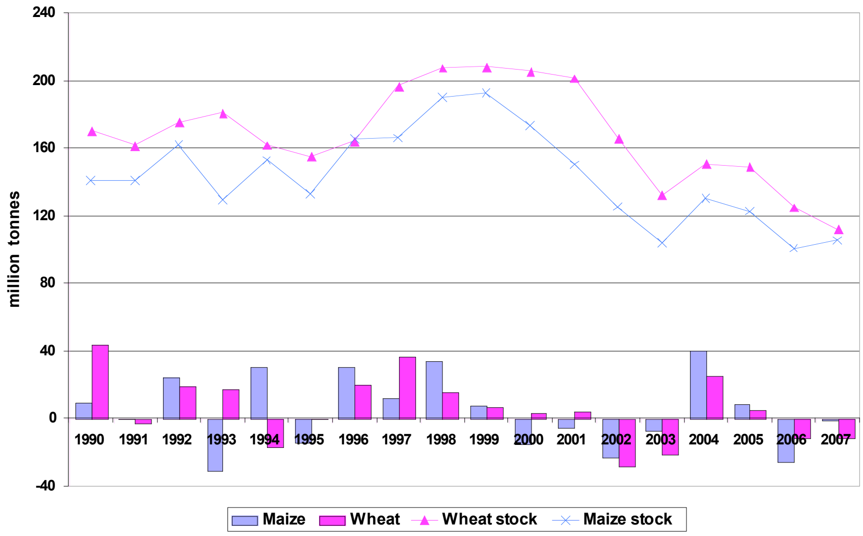


Figure 3: World wheat and maize -annual production surpluses, deficits and stocks[8]

To truly assess the impact of the changes in stocks they need to be compared with the rate of usage - calculated in days. From 2000/01 to 2007/08 the world's annual closing stocks of wheat and maize halved to 67 days and 50 days respectively.

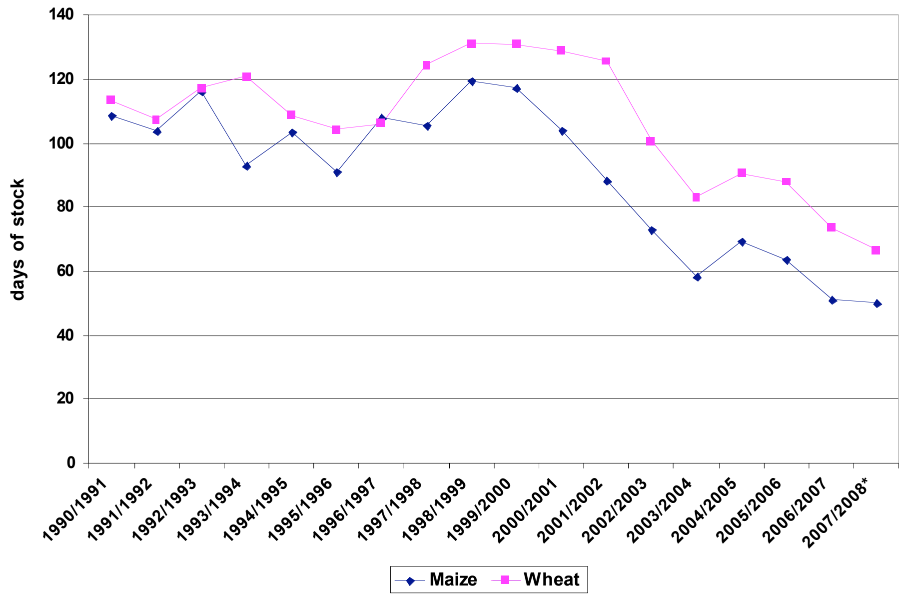


Figure 4: Cereal stock to use ratio

So why has production been falling behind?

Crop production is the product of the area planted and the yield per hectare. The forward price for the next harvest at time of planting has most influence on the farmers' planting decisions for the next crop. And it is the future price prospects that determine the investment made by the farmer in seeds, fertilisers, crop protection and labour to achieve the optimum yield per hectare.

The low cereal prices for the 10 years between 1996 and 2006 had the impact of reducing production as can be seen in Figure 5. The low stock in 2003 and the subsequent price increase stimulated a production response but it was not sustained because prices fell back again. The recent price spike that started in September 2006 was too late to influence farmers' wheat planting decisions for the 2007 harvest.

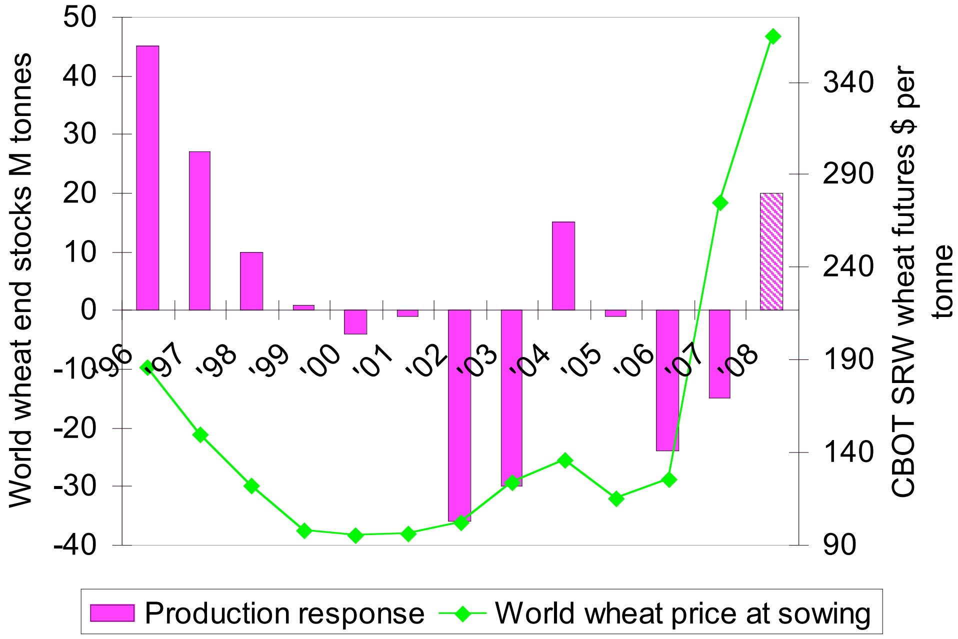


Figure 5: World wheat - production response to price signals[9]

Since the early 1990's farmers, and governments in Europe and USA, have held down cereal production because of the oversupply situation that occurred in the late 1980's and early 1990's when the high cereal stocks - mainly in the US, Canada, Australia and Europe - were described as the "Grain Mountains".(see Annex 3: The Grain Mountains)

Crop areas - The policy response to oversupply in Europe was to introduce compulsory set-aside for between 5% and 15% of arable land from 1992 in an effort to kerb production. Likewise in 1988 the USA had introduced the Conservation Reserve Program (CRP) to encourage US farmers to reduce their crop production area. Also during the same period there were large tracts of arable land being taken out of cereal production in the former Warsaw pact countries. They were in transition from a command economy to a market economy with confusion about land-ownership, little capital, poor infrastructure and limited market access.

In recent years the amount of set aside land in the EU25 was 7 Mha, in the USA the CRP land amounted to 15 Mha and the abandoned arable land in Ukraine, Kazakhstan and the Russian Federation was 23 Mha. This represents a loss of 45 Mha of cereal and oilseed production.

Figure 6 shows how the world land area allocated to wheat fell from about 230 Mha in 1996/7 down to a low of 210 Mha in 2003/04.

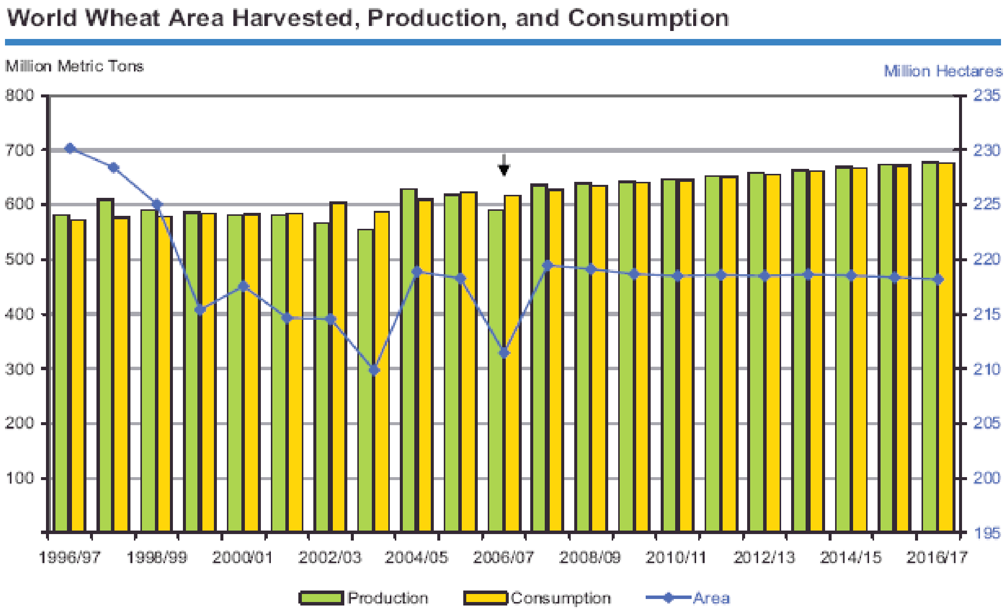


Figure 6: World wheat production, consumption and crop area

Crop yields - Average world crop yields per hectare have been rising steadily for decades, Figure 7, as farmers adopted better seed varieties and applied more advanced agronomy. But average world wheat yields have levelled off since the mid 1990's with the exception of 2004 - which followed a year of high prices. Was the levelling off of wheat yields another response to the low prices that occurred during that period?

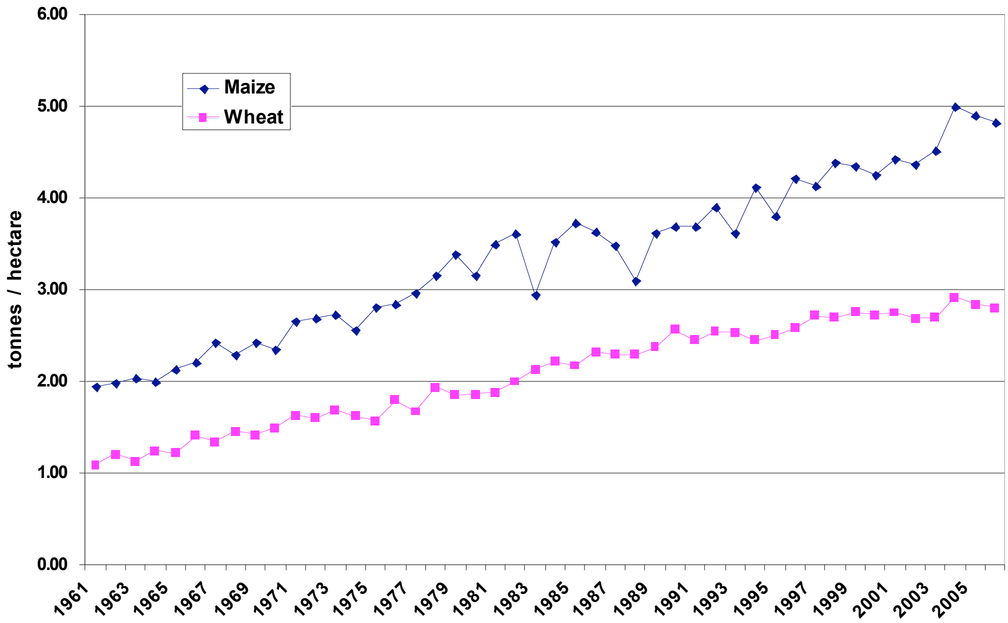


Figure 7: World maize and wheat yields per hectare[10]

Weather, pest & disease impacts - All agricultural commodities depend upon favourable weather conditions with sufficient water and sunshine to provide the desired crop yield. Modern agronomy with superior seeds and agrochemical treatments help to overcome many of the crop hazards. However farmers throughout history have always had to contend with the exceptional years when crop production has been severely affected by drought or flood.

In 2007 European harvests suffered from excessively wet weather in the western states and exceptionally dry weather in the eastern states[11]. Similar drought conditions were suffered in the grain growing regions of Southern Russia and the Ukraine. But the largest weather impacts on world grain prices in 2006 and 2007 were the Australian droughts that decimated grain production for two consecutive years.

Australia's harvest has a very important impact on the world grain market as it is one of the top four wheat exporters and its grain boosts world stocks in December about six months before the main northern hemisphere harvest arrives. The failure of the Australian harvest removed between 15 Mt and 20 Mt from the world market for two consecutive years.

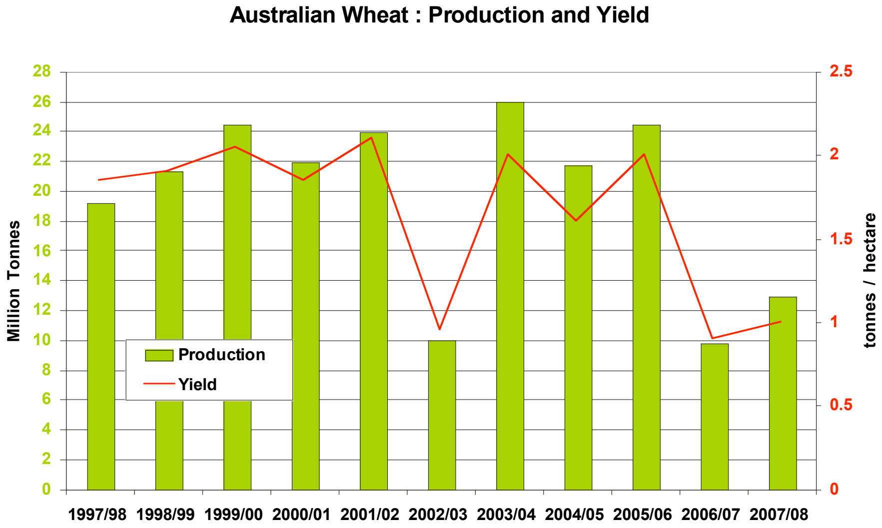


Figure 8: Australian wheat production 1998 to 2007[12]

Summary of fundamental factors that contributed to the price spike

Demand for wheat and maize had been rising at steady rates for 16 years but production was rising, on average, at slightly lower rates. Prices remained low in the early 1990s because of the high levels of stocks that were overhanging the market. Stocks continued to fall but as this was in keeping with public policy, that needed to see public grain stocks reduced, there were no concerns about food security. In any cases prices remained low and supplies seemed plentiful.

But grain stocks are a risk management tool. They provide a cushion when production falls behind demand and they can be used to dampen prices when surpluses build up again. They allow the market to withstand supply shocks.

Productivity increases had been disincentivised by public policy and by low world prices. Land was removed from use to reduce food production and in response to "privatisation" in some former Warsaw pact countries. Stocks were reduced in line with public policy. Then there was a series of poor harvests, supply shocks, which left a cereal shortfall that had to be balanced by the remaining world stocks.

In autumn 2006, following the poor European harvest and the realisation that the Australian harvest was at risk, world grain prices began to rise. But the price signal to encourage farmers to grow more cereals did not come in time to incentivise the planting of the winter crops for the 2007 harvest. US maize, which was planted in the spring of 2007, was the first major response to the rising prices and lifted US production by 65 Mt in one year[13].

The price spike of 2007/08 was due to the supply shocks from two consecutive disastrous Australian harvest and below average harvests in Europe, Russia and Ukraine. The supply shortfall could not be satisfied by the very low cereal stocks and, as these fundamental factors were not recognised by the traders until after the 2007 harvest had been planted, it was clear that the shortage would not be solved until the harvest of 2008.

In hindsight it is obvious that there was a market failure. The world's grain trade failed to recognise the signs that demand was steadily rising, stocks were falling, productivity increases were slowing and farmers were prevented from increasing crop areas by government supply control measures. All of these together should have triggered price increases earlier in 2006 when the reports of lower planting and poor crop conditions in Ukraine, India, Russia and Romania were reported in May 2006 and the adverse planting conditions in Australia started to be reported.[14]

The fundamental supply and demand factors were driving the market price upwards. It was then that other factors came into play to send prices even higher.

Speculation – Once the market volatility had increased, traders from the financial sector such as hedge funds started buying cereals. They recognised that prices were being driven by fundamentals and they may have had the impression that the developing biofuel markets would create a new paradigm where agricultural commodities would directly follow the mineral oil markets. They were able to use unprecedented funds to support the very high security, "margin call", that is required in volatile markets. The usual hedgers - grain consumers, traders and producers – became smaller players in bigger trading pool and were less influential in the markets. Prices moved further away from the fundamentals as was illustrated by the short term surge for Hard Red Spring Wheat (HRS) on the Minneapolis grain market in January and February 2008. (Figure 9: US Wheat & Maize prices) Prices reached levels that are so far above the cost of production that the response from growers across the globe will be to increase production in any way possible other traders recognised this and brought the market down dramatically within days. The growers response to the very high prices should not be underestimated.

".. the novelty of these markets is not the direct impact of biofuels on actual consumption but its impact on expectations". Error! Bookmark not

Government actions – the fear of food price inflation, political unpopularity and even civil strife made many governments take action to protect their own consumers. The Ukraine, Russia, Kazakhstan and Argentina imposed export controls on their cereals to dampen prices within home markets - having the impact of increasing world cereal prices. Other countries, such as the EU, reduced import restrictions to provide access to more world market grain – putting further upward pressure on prices. India decided to import more cereals so that they could build higher stocks to improve their own food security – causing more upward pressure on prices. According to the Economist at least 30 countries imposed some form of food trade restraint[15]. These short term measures, especially export restrictions,

WASHINGTON, April 24, 2008 *The World Bank Group President is calling on food producing countries to keep markets open. "We are urging countries not to use export bans to try and protect domestic supply. These controls encourage hoarding, drive up prices and hurt the poorest people around the world who are struggling to feed themselves."16* disincentivise future production within those countries and prevent the market from solving the shortage by increasing supply. In Argentina such policies have led to large scale civil disruption by farmers protesting at export taxes and quotas that restrict their access to the world market.[16]

Freight rates – The cost of moving cereals around the world from the major exporting nations to the consumers has risen tenfold since 2000 and risen 150% since January 2007. This has come from demand pressures for many bulk commodities for China – especially iron ore. Freight rates are also being pushed up by soaring fuel oil prices.[17]

Currency and Interest rates

Most of the world's commodities are quoted and traded in US$ terms so that the quoted prices are partly distorted in terms of independent currencies such as the Euro. Since the beginning of 2006 the US$ has fallen more then 20% against the Euro.

> ***Economist 1st May 2008*** *-Jeff Frankel, a Harvard economist, has long argued that low real interest rates lead to higher commodity prices. When real rates fall, he points out, commodity producers have more incentive to keep their asset—whether crude oil, gold or grain—in the ground or in a silo, than to sell today. Speculators, in turn, have more incentive to shift into commodities. There is no doubt that commodities have become an increasingly popular investment category—in fact they bear many of the hallmarks of a speculative bubble.*[18]

Some economists believe that the falling value of the US$ and the aggressive reduction of US interest rates, that make it even weaker, are fuelling commodity inflation by reducing the cost of stockholding and incentivising the use of commodities as a hedge against currency devaluation.[18]

So the fundamentals are driving the markets and the speculation, government actions, currency devaluation, very low interest rates and high freight costs are adding to the price volatility.

So where does the use of cereals for bioethanol fit in?

2.2 Impact of current bioethanol production on the cereal price spike

To understand what impact cereal consumption for bioethanol has had on the price spike it is necessary to consider

- the scale of cereal usage compared to the total markets
- the impact of bioethanol production on world trade
- the countervailing impact of co-products
- usage of non-food crops
- the type of cereal used; and
- the competition for land with other crops

2.2.1 Scale

The usage of cereals for bioethanol across the world is shown in Table 1. The data was from the European Commission, FO Licht, International Grains Council and trade sources. In 2007 the US and China increased their use of maize for bioethanol, Canada increased usage of feed wheat and barley whereas the EU actually reduced its cereal consumption for the renewable fuel. The total increase in cereal use for bioethanol was 19.8 Mt during a year when world cereal production increased by 100 Mt.

Cereal consumption for bioethanol	2006/07 thousand tonnes	2007/08 thousand tonnes	Change thousand tonnes
EU27	**2,500**	**1,900**	-600
Canada	1,430	2,010	580
United States	44,797	62,583	17,786
Paraguay	0	14	14
Australia	104	104	0
China	3,511	4,016	505
World cereal usage for bioethanol	**52,439**	**72,282**	**19,843**
World cereal production	**2,009,000**	**2,109,000**	**100,000**

Table 1: Usage of cereals for bioethanol[19]

Therefore in 2007/08 it is expected that the world will use 3.4% of its cereal production for bioethanol.

The increased cereal usage of 19.8 Mt for bioethanol in 2007/08 compared to 2006/07 represents an increased cereal demand of less than 1%. In that same period the FOA world cereal prices index rose by 77%[20].

Having established the scale of the cereal usage for bioethanol the study now considers the type of cereal used for bioethanol and the competition for land in the context of the three largest users of cereals for bioethanol – USA, China and the EU.

2.2.2 US cereal use for bioethanol

The US is the world's largest user of cereals for bioethanol production. In 2007/08 it is expected to use 64.6 Mt of its 420 Mt harvest for bioethanol[21]. The US is also the world's largest exporter of cereals and so any reduction in US exports will lower world grain supply and tend to raise prices.

The prices of US grain, and a good indicator for world market prices, can be seen in Figure 9. It shows US futures prices for Chicago Board of Trade (CBOT) Maize, CBOT Soft Red Winter Wheat (SRW), and the Minneapolis futures contract for Hard Red Spring Wheat (HRS). Maize is mainly fed to livestock and used for bioethanol within the US and China because it has a high starch content that can be used to provide energy in animal feed or can be converted to bioethanol. US wheat is almost exclusively used for human consumption – mainly as flour in bread, biscuits and cakes - with the HRS being the finest quality.

The largest price movements since early 2006 were HRS (+249%) and SRW (+211%) indicating that these milling wheats were the commodities that were undersupplied – or perceived to be undersupplied by the hedgers and speculators. No flour milling grade wheats are used for bioethanol – as they always command a premium over the feed cereals.

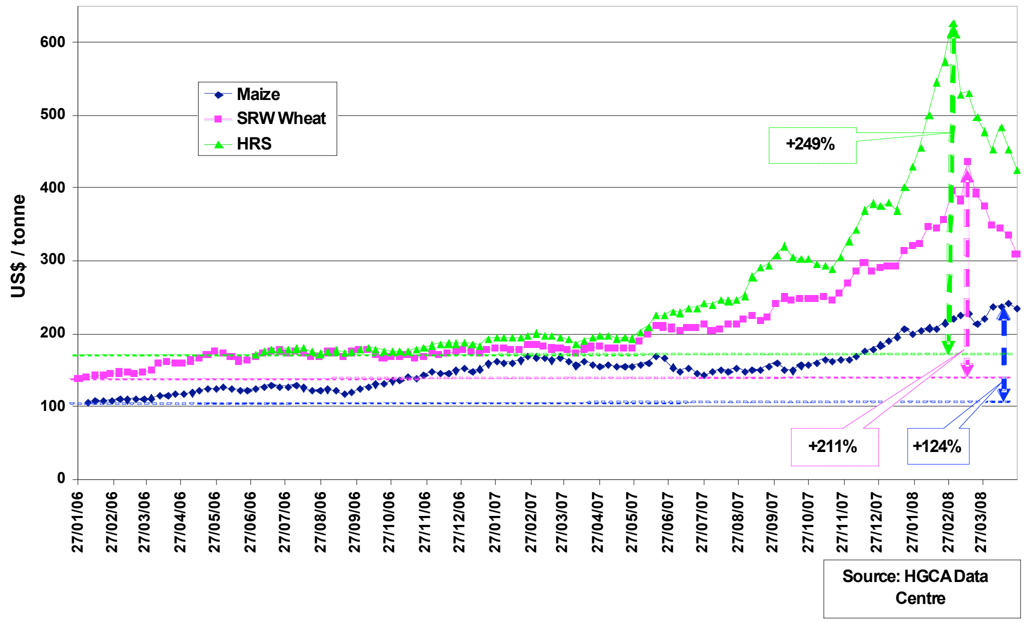


Figure 9: US Wheat & Maize prices

The chart clearly demonstrates that the most significant price increases have occurred on the human food grade cereals – not for maize which is the feed and industrial cereal.

A shortage of wheat supplies in the US could be caused by a smaller area being planted with the crop or reduced crop yields per hectare. It could be suggested that the record area of maize actually led to a loss of wheat area.

But in the US the reallocation of land to maize has not caused a reduction in the land area allocated to wheat. Figure 10 shows that it were oilseeds, principally soya, that were displaced by maize when farmers responded to the high maize prices in the spring of 2007 by planting the highest area for the crop since 1944.[22]

***WASHINGTON, Jan. 11, 2008** – The 2007 U.S. corn crop was one for the record books, with 13.1 billion bushels (333 Mt) of production eclipsing the previous high, set in 2004, of 11.8 billion bushels (300 Mt) The 2007 production level was up 24 percent from 2006.*

Driven by favourable prices, growing ethanol demand and strong export sales, farmers in nearly all states increased their corn acreage in 2007. Planted area, at 93.6 million acres, was up 19 percent from 2006 to the highest level since 1944, when farmers planted 95.5 million acres.[22]

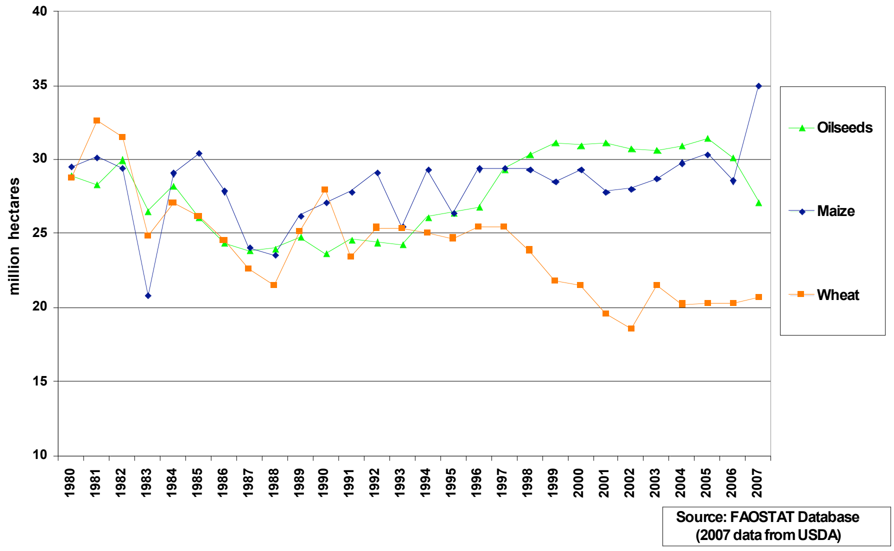


Figure 10: Crop land allocation in the USA

The maize land allocation for feed, industrial and ethanol uses in the USA has not reduced the area required for wheat – the crop that is in short supply – and so land allocation change has not contributed to rising wheat prices. However, the displacement of soybeans has had an adverse impact on vegetable oil and feed protein prices.

Exports are the main indicator of the scale of crop surpluses within a country. Table 2 shows that despite increased demand of 17.8 Mt of cereals bioethanol between 2006/07 and 2007/08 the US did not reduce its maize exports and was able to increase its wheat exports by 6.8 Mt.

	2006/07	2007/08
Maize	56.0	56.5
Wheat	24.7	31.5

Table 2: US cereal exports in million tonnes[23]

2.2.3 China's cereal use for bioethanol

China, despite its rapidly growing population and improved living standards, continues to be virtually self sufficient in all cereals as judged by the level of imports and exports.

	2005/06		2006/07		2007/08	
	Imports	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**
Maize	5.0	5.9	4.6	4.5	4.9	2.0
Wheat	2.8	0.5	1.9	1.8	2.2	2.6

Table 3: China's wheat and maize imports and exports in million tonnes[24]

In 2006/07 China used 3.5 Mt of cereals to produce bioethanol and it is forecast to use 4 Mt in 2007/08 - representing 1% of cereal production.

The forecast increase of 0.5 Mt in cereal use for bioethanol still leaves the country with exports of 2 Mt of maize and 2.6 Mt of wheat. China's use of cereals for bioethanol does not have an impact of overall availability within the country nor does it change its level of cereal demand from the world market.

2.2.4 Impact of EU bioethanol production on the grain price spike

The price of Europe's milling wheat that is used to make bread and many other human foods rose by 164% between January 2006 and March 2008. These were the highest prices ever recorded in the contract's 12 year trading history. (Figure 11)

Figure 11: European milling wheat prices[25]

But the main cereal that is used for producing European bioethanol is feed grade wheat.[26] This is the type of wheat traded on the London International Financial Futures and Options Exchange (LIFFE). Figure 12 illustrates the historic weekly average price for LIFFE Feed wheat for the May 2008 delivery position[27].

The May 08 price started trading at the end of January 2006 when it was €120/t and it peaked at €279/t in September 2007. This rise of 132% was very significant but not as extreme as the 164% rise in milling wheat, Figure 11, over a similar period.

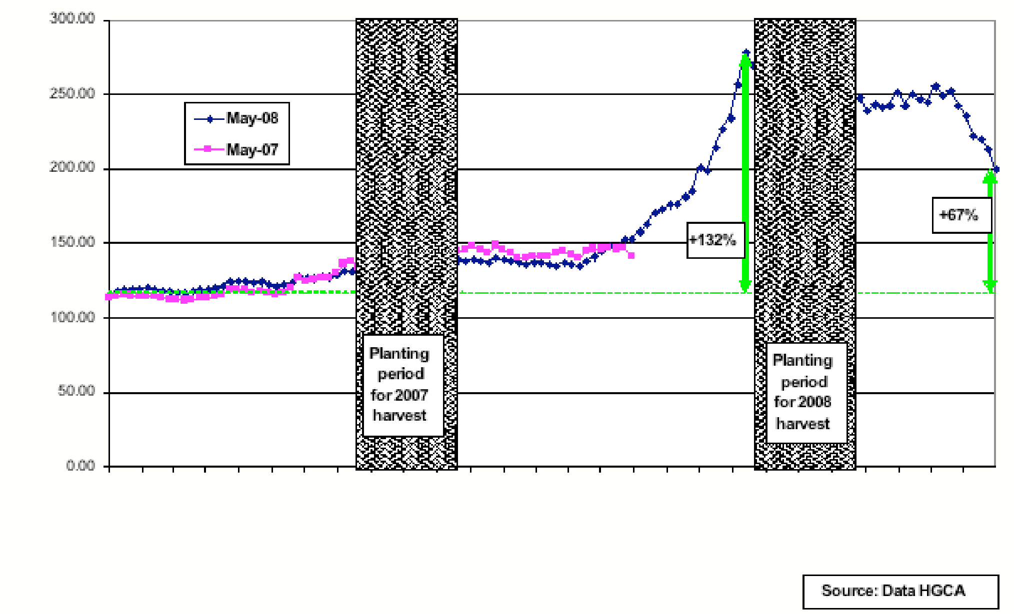


Figure 12: EU Feed weekly wheat prices (LIFFE May-07 & May-08)[28]

The usage of cereals for bioethanol in the EU25 was estimated by DG AGRI to be less than 1% of overall cereal disposals[29] in 2005/6 and 2006/7. Its estimate for 2007/08 was only 0.68% as can be seen in Table 4 where it should be noted that despite the consumption of cereals for bioethanol the EU 25 maintained cereal exports to the world market.

EU25 Cereal Usage	2004/05	2005/06	2006/07	2007/08
Bioethanol	0.7	2.7	2.5	1.9
Food, feed & other	243.0	246.9	247.4	254.6
Exports	23.3	23.5	21.7	18.0
Imports	10.1	9.9	10.9	16.9
Total Disposals	**262.8**	**270.2**	**270.9**	**276.3**
% bioethanol	0.27%	0.99%	0.92%	0.68%

Table 4: Estimated cereal use for bioethanol[30]

In a commodity market any change in demand without a corresponding increase in supply will have an impact on the supply-demand balance and shift the price up or down towards a new equilibrium.

However over the period from 2005/06 to 2007/08 the EU reduced its cereal exports by 5.5 Mt and increased its exports by 7 Mt. The net impact on the world cereal market was to remove 12 Mt from the market thus putting upward pressure on prices.

To estimate the impact on EU cereal prices from using cereals for bioethanol the study has used a formula for the long term price and its relationship to crop surplus that was applied by DG AGRI when assessing the impact of the biofuel targets for 2020[31]. It is assumed that EU25 grain prices are determined by the scale of cereal exports required to balance the internal market.

The formula[32] shows an inverse relationship between the price of the cereal and the amount of exports.

When using this formula, and a notional average wheat price of €200/tonne, the reduction in exports caused by using 2.5 Mt for bioethanol in 2006/7 would theoretically raise the internal average grain price by €0.93 per tonne. The 1.9 Mt estimated usage rate for 2007/8 would raise prices by about €0.70 per tonne. Even if this calculation is an underestimate of the price reaction the principle is correct.

To assess the impact of bioethanol on grain prices the comparison should be made against the change in demand for cereals for bioethanol over the period that prices have been rising.

As illustrated in Table 4 the usage of cereals for European bioethanol has been falling from its peak of 2.7 Mt in 2005/06 to an estimated 1.9 Mt in 2007/08. Therefore, the reduction in demand should have had a dampening effect on grain prices. The fact that since the beginning of 2006 feed grain prices rose by 67% (at one stage 132%) and at the same time cereal consumption for bioethanol fell by 30% indicates that the volume of cereals used within Europe for bioethanol production has had no measurable impact on the cost of feed grains in either direction.

Set aside – The cereals used for bioethanol included grain that had been contracted to be grown on set-aside land where farmers were not permitted to grow food crops. These were cereals that were legally debarred for use as food or feed and so their use for bioethanol had no impact whatever on the food market.

	2005/06	2006/07	2007/08
Cereals	592,000	700,000	800,000
% of cereal for bioethanol	22%	28%	42%

Table 5: Cereals grown on set-aside for bioethanol production[33]

So if bioethanol had little impact on internal grain prices there is no justification to assert that bioethanol is linked to food price increases. But the link between grain prices and consumer prices is now considered as it illustrates the source of some of the food price increase.

2.2.5 Impact of the main cereal for bioethanol producer countries on the world cereal supply demand balance

The price of grain traded in the world grain market is determined by the overall supply and demand. It has already been demonstrated that there was not a demand shock and that the problems with shortage of supply drove the prices upward.

Therefore if traditional exporters reduced the grain available to the markets outside of their borders they would cause prices to rise. Prices would also rise if traditional importers drew more grain into their home markets.

During the period from 2005/06 to 2007/08 the world's leading cereal-to-bioethanol countries; USA, China and the EU continued their export and import programmes. Figure 13 shows that the USA, despite consuming 63 Mt of cereal in 2007/08, is still forecast to export 4.3 Mt of extra wheat and 5.2 Mt more maize onto the world market. China is expected use 4 Mt of cereals for bioethanol and increase net wheat exports by 2.7 Mt. It will however import an additional 3.8 Mt of maize. However the EU, which will use 1.9 Mt of cereals for bioethanol, will reduce net wheat exports by 5.6 Mt and lower net maize exports by 6.8 Mt.

During the period the US exported 9.5 Mt of extra wheat and maize onto the world market whereas China took an extra 1.1 Mt from the market and the EU reduced the world pool by 12.4 Mt compared to 2005.

The US exports tended to reduce world price, China's impact was neutral whereas the EU would have tended to increase prices by reducing exports and increasing wheat and maize imports.

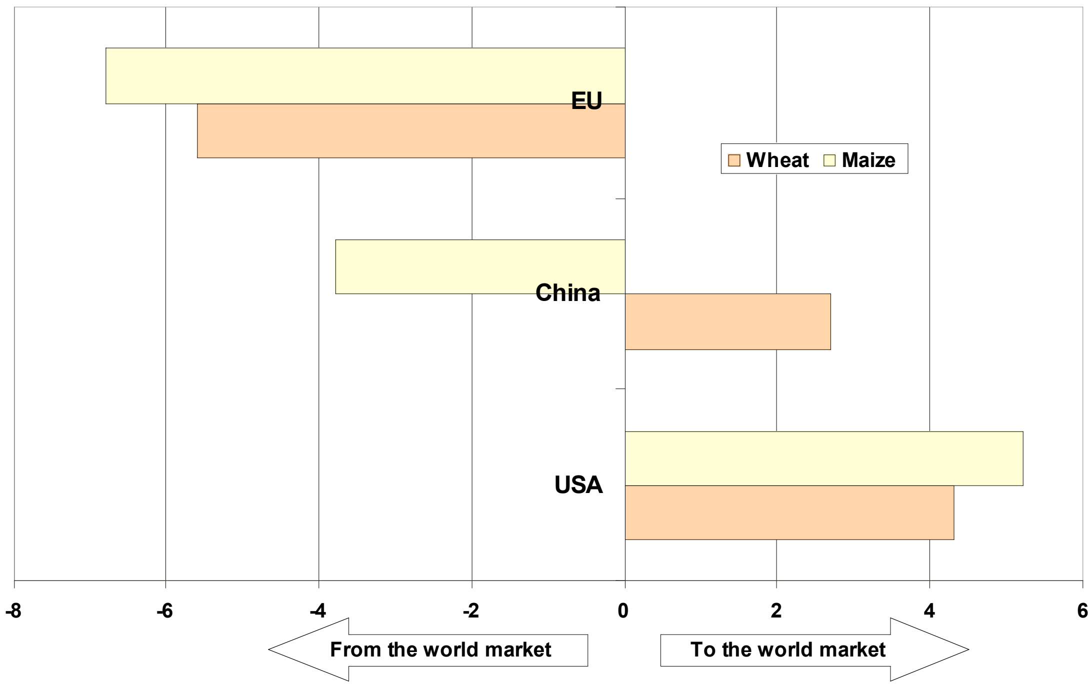


Figure 13: Net change in cereal exports of wheat and maize from the top three cereal-to-bioethanol producers 2005/6 to 2007/08.

Further details of changes in trade balances can be seen in Annex 1: Cereal trade balances 2005/06 to 2007/08 where the most impacts on wheat supply were caused by Australia, Ukraine, Turkey, India, the EU and Brazil. The countries that had the most positive impact on wheat supply were Kazakhstan, the USA, China, Iraq, Argentina and Iran.

However cereal demand has been reduced by the supply of about 41Mt of feed co-products, DDGS, from bioethanol plants in the US, China and the EU. These have tended to reduce demand, and restrain prices, for cereals and protein ingredients.

Between 2005/06 and 2007/08 the net impact of the main cereal bioethanol production countries on the world grain and feed markets was to put more grain and feed into the world pool and restrain world prices.

2.3 Sensitivity of food prices to the cost of grain

As illustrated in Figure 11 European milling wheat prices rose more dramatically than feed wheat – up by 164% at its peak compared to the feed wheat peak of 132%.

But these grain price changes should not be reflected in retail price of food because the raw cereal is only a small proportion of the cost make up on cereal based foods. Figure 14 shows how, over a thirty year period, the cost make-up of processed cereal products has changed. The basic cereal component almost halved from 33.3% to 17% but the cost of brand marketing and advertising rose from 17% to 52%.

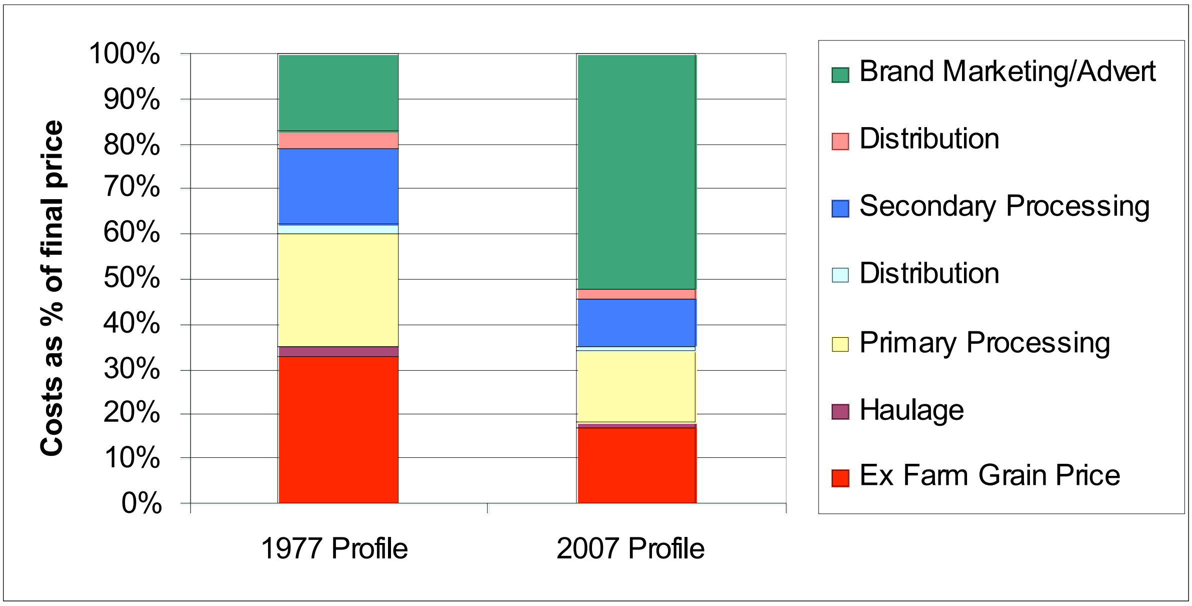


Figure 14: Cost component of processed cereal products (UK)[34]

In a loaf of bread the raw material component is even less. In September 2007 DG AGRI estimated that the impact of a 78% wheat price increase from the year earlier should have only resulted in a 4% increase in the price of bread[35]. This indicates that the raw wheat component represents 5% of the consumer price of bread.

This disconnect between farm gate cereal prices and food prices is further demonstrated in Figure 15 where agricultural commodity prices were relatively flat for the period 2000 to 2007 but CPI food index steadily rose by more than 20%. It was the non agricultural cost components and/or margins that were causing the food price increases.

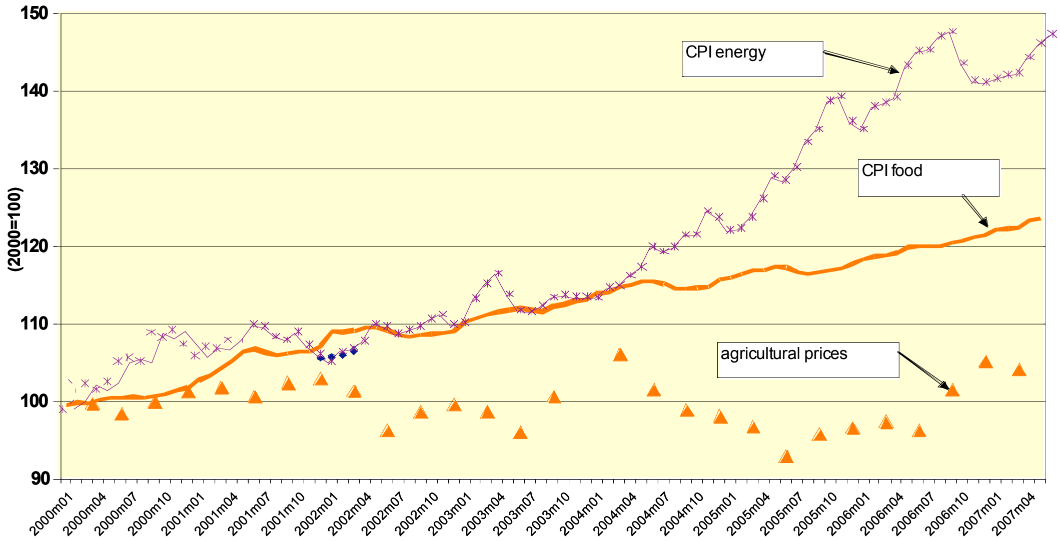


Figure 15: Development of nominal producer prices and consumer prices in the EU27[36] (Jan 2000 = 100)

The rate of cost dilution for each consumer will depend upon their type of diet. Consumers in Europe and other developed nations will have a high level of price dilution but for people on more basic subsistence diets, such as in many developing countries, the food price changes will be nearer to those of the basic cereal price.

The real social problems from higher food prices will be felt by the world's poor such as those who have migrated to cities from the rural areas where low prices made it uneconomic to grow crops and employ local labour. A reinvigorated rural sector would help to stem the flow of migrants from the countryside by sustaining, or even increasing, agricultural employment.

2.4 Conclusions

Grain Prices – key points

It is the balance of supply and demand that determines **grain prices.**

- From 1990 to 2007 the world's long term wheat and maize supply growth trends have been falling behind the long term demand growth trends. On average a shortfall of 0.7 Mt/yr for wheat and 1.7 Mt/yr for maize
- From the early 1990's the EU and the US were paying farmers to stop growing food crops on 22 Mha of Arable land. In the same period 23 Mha of arable land went idle in Russia, Kazakhstan and the Ukraine during the political restructuring in the former Warsaw pact states.
- Low grain prices for much of the period, often below the cost of production, caused productivity to stagnate – very little yield improvement since the early 1990's
- Both the US and the EU subsidised cereal exports and depressed world market prices - undermining cereal production in the developing world

- All of the above contributed to the erosion of the world's wheat and maize stocks
- The result was that there was no longer a buffer against supply shocks to restrain prices.
- In 2006 and 2007 the supply shocks came. Two consecutive disastrous harvests in Australia and poor harvests in Europe, Ukraine and Russia. The shocks led to the largest price increases, in real terms, for a generation.
- The price signals that tell growers that it is worthwhile to plant more crops and to aim for higher yields came too late to have any impact on the winter cereals in the Northern hemisphere for the 2007 harvest. But the US farmers responded with their spring planted maize crop by increasing production by 65 Mt in one season.
- The market fundamentals pointed to higher prices to get farmers to respond by increasing supply and consumers, such as the feed and bioethanol sectors, to reduce demand by using alternative commodities.
- Other factors were then causing grain prices to rise
  - Government actions to tax or restrict exports
  - Speculation by large financial funds who saw the commodities market as a good inflation hedge against a falling US$ - especially when lower interest rates made it easier to fund long positions
  - Freight rates rose because of high levels of demand for bulk minerals to China and fuel costs
  - Crude oil costs rose by 600% between the beginning of 2006 and early 2008 - increasing the floor price at which grain farmers could break-even because of higher cost of farm energy and fertilisers

Cereal for bioethanol – key points

- The world's leading cereal bioethanol producers are the US, China and the EU that, in 2007/08, are expected to consume 63 Mt, 4 Mt and 1.9 Mt of cereals respectively for bioethanol production.
- Since 2005/06 the USA, the only large volume cereal to bioethanol producer, has increased its supply of wheat and maize to the rest of the world by 9.5 Mt - putting downward pressure on prices
- In China and the EU cereal consumption for bioethanol represents such a small proportion, circa 1%, of domestic cereal production to have no impact on world prices.
- In 2007/08 cereal to bioethanol producers will supply 25 Mt of protein feeds to the world market that will tend to dampen prices for feed ingredients including cereals and protein ingredients.
- In 2007/08 cereal bioethanol producers in the European Union have sourced more than 40% of their cereals from land that was not permitted to grow food crops.

Food Prices and grain prices

- Movements in grain prices do not equal those of food prices in the developed world as cereals only represent a small part of the consumer cost. In the case of bread it is less than 5%.
- In the developing world the impact of food price increases are more significant as there is less dilution through the supply chain. However the cost of freight and energy for flour and bread production are still important elements in total food costs.

Clearly a shortage of grain will drive up prices but the other actors along the supply chain add to the final food cost. There is evidence that throughout the food supply chain traders and processors are using the raw material

> *"Energy, transport and labour costs have risen. But it is possible that somewhere along the food chain someone may be doing well out of this. We are not drawing conclusions; we are just presenting facts."*
>
> *Commissioner Mariann Fischer Boel*[37]

cost increases to justify larger food price increases than can be supported by the cereal ingredient cost. They may be taking the opportunity to re-establish or improve their profit margins.[37]

Grain prices rose dramatically because supply has been falling behind demand since the early 1990's causing grain stocks to fall. This occurred because land was taken out of production and prices were so low that it was unprofitable for many farmers to produce the crops. The weather induced supply shocks of 2006 and 2007 from Australia, Ukraine and Europe could not be covered by the low world stocks. Speculation, poor government decisions and energy costs have driven prices even higher.

It is likely that the greatest impact of biofuels on the cereal markets, and to a lesser extend on the food markets, has been the expectation by speculators that biofuels would become linked to oil prices and drag up the price of cereals. The opposite link is more likely to be true that the increasing cost of fossil fuel is driving up the cost of food production.

The FAO estimated in April 2008 that biofuels contributed about 10% of the food price increase and argues that the surge in oil prices - through costlier diesel and fertiliser – is having a greater impact on food prices.[38]. This is in the same order as the 15% estimate given by the President of the American Farm Bureau Federation who also cites higher oil prices were the main factor causing food prices to rise[39].

The assertions that using cereals for bioethanol has caused the food price spike are not justified by the analysis of the available data. A larger proportion of the price impact is related to increased energy costs all along the supply chain. Biofuels are now helping to dampen oil prices so that they can help to ease some of the upward pressure on prices.

3 2020 Biofuel scenarios

To assess the impacts of the 2020 biofuel target on the grain markets, and by extension the food markets, the study has prepared a range of scenarios. These are in addition to those used by the commission when they prepared supporting material for Biofuel Progress Report where the the 10% biofuel target for 2020 was first proposed.

3.1 Commission Scenarios

The Commission provided biofuel scenarios[40] for 2020 ranging from the "business as usual" case of 6.9 Mtoe (2.2%) through to the "optimal" 14% target plus two 10% scenarios that illustrate how the minimum target can be achieved. These are summarised below in Figure 16

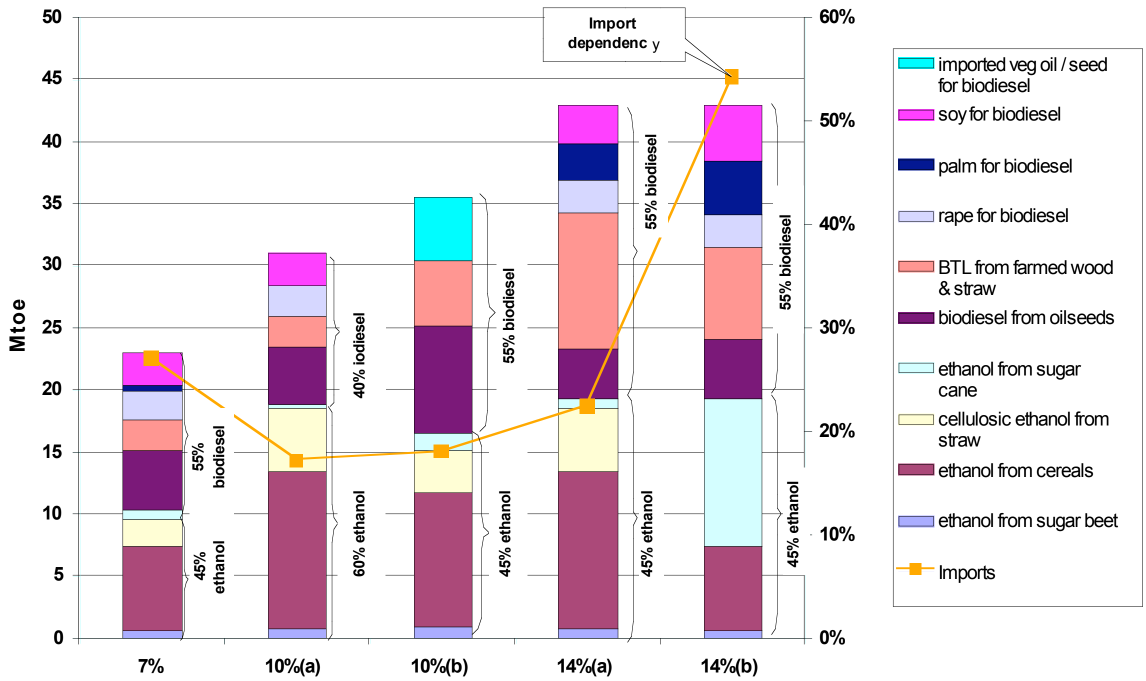


Figure 16: 2020 biofuel sources for 5 scenarios

The scenarios differ in the

- scale of biofuel consumed (23 Mtoe to 43 Mtoe)
- mix between biodiesel and bioethanol (55/45 and 40/60)
- proportion of imports (17% to 54%)
- dependence upon commercialisation of new biofuel technology (20% to 37%)

The detailed breakdown may be seen in Annex 2: Analysis of 5 EC 2020 scenarios.

3.2 Alternative Scenarios

All of the EC scenarios depend upon importing biofuels and/or their feedstocks, and also rely upon the commercialisation of BLT and ligno-cellulosic processes by 2020. It is assumed that biofuels and feedstocks can be sourced sustainably from outside and inside of the EU and that there will be sufficient supplies of biofuel available from the world market.

The potential least cost option of 100% biofuel imports was not illustrated nor did the scenarios explore the boundaries of what mix of biofuels could be consumed by the transport vehicle fleet in 2020. Furthermore, there was no assessment of the impact of increasingly stringent environmental constraints on crop production that are likely to restrain the ability of growers to respond to future demand by increasing productivity.

This study therefore has developed three core scenarios, Table 6, and compares them with the DG Tren scenario described earlier as 10%(a). E is an All Import scenario that has the same internal EU impacts on food prices and food security as the Zero Biofuel scenario (B).

	B	C	D
Description	Zero Biofuels target	Max EU biofuel production from EU feedstocks	Achieving the 10% target from EU feedstocks but productivity restrained by environmental restrictions
Assumptions	No targets but left to open market to use biofuels if they are competitive with fossil fuels	No 2nd generation biofuels. No imported biofuels or feedstocks. No further environmental restrictions that impede crop productivity.	EU crop yields limited by environmental constraints. 2nd generation and imports not required to meet 10% target.
Constants	Oilseed and sugar beet yield increases @ 2% p.a., cereal exports would be maintained at 30 Mt per annum[41] in preference to biofuel use – if possible.		
Variables	Cereal yields, Biofuel split, Import availability, Crop allocation, Land use and Ethanol yield		
Constraints	Existing limited inclusion rates of ethanol and biodiesel set by standard fuel specifications. Cross compliance for agriculture	No constraints on biofuel consumption but it will ultimately be limited by the capacity of the 2020 vehicle fleet. Practical cap on oilseed area and a floor on its use in rotation. Cross compliance for agriculture	10% biofuel target Stricter cross compliance criteria that further inhibits the use of Nitrogen fertiliser

Table 6: Alternative scenario descriptions

To test these scenarios it was necessary to define the boundaries within which the variables can be stretched.

- The maximum amount of individual biofuels that can be used by the 2020 fleet
- The availability of the biofuels from the world market
- Cereal yield projections based upon historical performance
- Cap and floor on oilseed area

3.2.1 Boundaries and ranges

3.2.1.1 The maximum amount of bioethanol that can be used by the 2020 fleet

The maximum amount of bioethanol that can be consumed in the 2020 road transport fleet depends upon the number, type of and use of vehicles by 2020. The actual biofuel usage will be constrained by the technical capacity of the engines to use biofuels and the economic competitiveness of biofuels compared to fossil fuels and alternative transport.

Biodiesel is less constrained than bioethanol because of the growing market for diesel type fuel and the access to the HGV sector that is able to handle higher blends without engine modifications. However, the variability of biodiesel quality, which is largely related to the type of feedstock, is proving a challenge for engine manufacturers for the light vehicles.

Early in 2008 all car manufacturers submitted their reports to the German government on the compatibility of using bioethanol in an E10 blend. They all confirmed that their current models are suitable for E10 fuel but a few older models with 1st generation gasoline direct injection technology will not be compatible[42].

Road transport fleet

In 2006 the European vehicle fleet was made up of more than 250 million vehicles: 225 million cars, 20 million light vans and 6 million trucks[43]. The average age of the European car fleet was about 8 years and about 70% of the cars on EU roads were less than 10 years old. The average annual distance travelled by a car in the EU was about 15 000 km/year. Car ownership in Western Europe in 2006 was 508 per thousand inhabitants whereas in the new Member States it was 186. The fuel mix for passemger cars was 68% petrol and 31% diesel.

Fuel usage and split

The dieselisation trend, the shift from petrol engines cars to diesel engines as old petrol cars are replaced by new diesels, is forecast by DG TREN[44] to lead to a fuel sale mix of 55% diesel and 45% petrol compatible fuels by 2020.

As the total road transport fuel usage for 2020 has been estimated to be 310 Mtoe then 170.5 Mtoe be for diesel type engines and 139.5 Mtoe for petrol compatible engines - but the actual fuel used need not be fossil diesel or petrol. Biodiesel can be used in all modern diesel engines and bioethanol can be used in all modern petrol engines – including Flex-Fuel Vehicles (FFVs). In addition ethanol can be used as a low blend in diesel fuel and at 95% in specially adapted diesel engines for buses and heavy goods vehicles. (Table 7)

POTENTIAL USES FOR BIOETHANOL	Fuel Description	Fuel range by volume	Vehicle type	Limitations
Low blends in petrol engines	E10	Up to 10%	Standard cars	Now approved for all modern vehicles by OEMs
Medium blends in petrol engines	E20	Up to 20%	New Standard cars	New designs being "future proofed" to run on E20
High blends in petrol engines	E85	Up to 85%	FFV cars	Limited to special Flexi-fuel engines and fuel distribution
Low blends in diesel engines	ED7.7	Up to 7.7%	HGVs, buses and cars	Limited to bunkered fleets because flash point limits forecourt potential
High blends in diesel engines	ED95	Up to 95%	HGVs, buses and cars	Limited to bunkered fleets because flash point limits forecourt potential
POTENTIAL USES FOR BIODIESEL				
Low blends in diesel engines	B10	Up to 10%	HGVs, buses and cars	Limited by warranty from OEMs
High blends in diesel engines	B30	Up to 30%	HGVs, buses and cars	Limited by warranty from OEMs and fuel distribution
High blends in diesel engines	B100	Up to 100%	HGVs, buses and cars	Limited by warranty from OEMs and fuel distribution

Table 7: Uses of biofuels for road transport vehicles

The maximum capacity for bioethanol to be used by the EU vehicle fleet by 2020, the cap, could fall into three categories Low, Medium or High.

Low cap for bioethanol demand - Based upon current 5% biofuel limits in standard diesel and petrol and ignoring the negligible use in high blends, the volume of bioethanol would be capped, in energy terms, at 3.2%. This equates to 4.48 Mtoe of bioethanol by 2020.

Medium cap on bioethanol demand - The most likely situation is that a 10% bioethanol blend in petrol will be approved as it is already warranted by the same motor manufacturers in the US[45]. Additional ethanol would be used by an expanding fleet of FFVs and a small amount used in diesel for buses and some HGVs. A 10% blend would, on its own substitute, 6.4% of all petrol by energy content. However this figure will be reduced by the expanding FFV fleet that will displace vehicles that used the standard 10% blend.

- **FFV assumptions:** an annual vehicle turnover of 7%[46] , a starting pool of 100,000 FFVs in 2010[47] (0.04% of the car fleet), an increasing proportion of FFV in new car sales - starting at 5% from 2010 and rising to 20% by 2020.[48] Under these assumptions FFVs would reach about 8.6% of the EU fleet by 2020. In Figure 17 it is assumed that the utilisation of E85 fuel in the FFVs was reduced by applying an availability factor of 30% in the early years to allow for lack of E85 fuelling infrastructure. By 2020 it was assumed that FFV drivers would fill their cars with E85 on 80% of occasions.

On the basis of these assumptions the medium cap on bioethanol demand will be 20.8 Mtoe

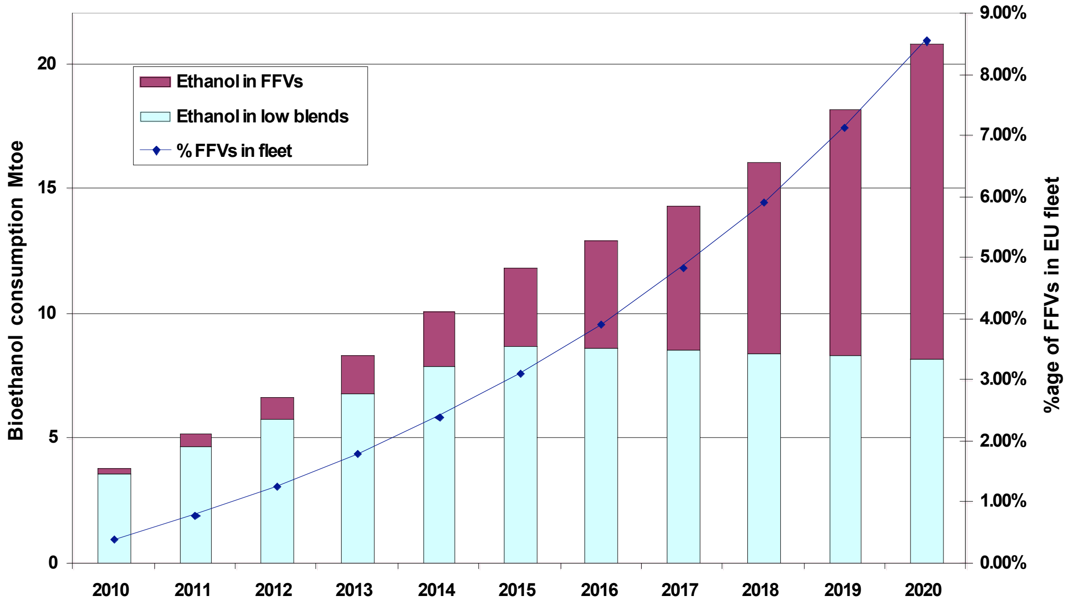


Figure 17: Mid range EU bioethanol market capacity assuming a moderate take up of FFV cars & 10% blend in standard petrol.

High cap on bioethanol demand – there are potential developments where higher consumption rates could apply

- A higher take-up of FFV cars
- Higher rate of low blends such as < 20%
- The introduction of small high compression engines that more efficiently use the high octane within bioethanol
- The use of bioethanol as a diesel blending component
- E95 in diesel engines for buses and HGVs

The ability to develop the ethanol diesel blends is restricted by flash point considerations, major changes to the diesel fleet would be required to create large scale consumption of E95, and the potential to stretch beyond the 10% blend in standard petrol engines depends upon the OEMs designing the standard models to accept the higher blend.

The major increase in bioethanol usage that is most feasible, in the near term, is the accelerated introduction of FFV cars as standard models. Bioethanol consumption could then increase by as much as the distribution system and its competitiveness allows. The technical bioethanol cap would then be 85% of the compatible fleets' fuel consumption. A demand figure of 95 Mtoe[49] of bioethanol is theoretically achievable assuming that 80% of all petrol engines ran on E85.

Assumed technical cap on EU bioethanol for 2020 - This study has assumed that bioethanol usage in Europe in 2020 will be capped at 20.8 Mtoe, as calculated from the Medium Cap described above and shown in Figure 17 and any excess production would be exported.

3.2.1.2 The availability of biofuels from the world market

The Commission's scenarios as detailed in 3.1 all assumed a reliance upon imported fuel bioethanol and biodiesel feedstocks. In the case of bioethanol the scale of what will be available for Europe will depend upon

- Productive capacity in other parts of the world
- Competitive demand for the fuel both internal and export
- Carbon, environmental and social criteria applied to bioethanol production
- Market access & Fuel standards

Under a high import scenario for bioethanol the most likely source would be the established world leader and least cost producer - Brazil. Other sugar cane based bioethanol producers in the developing world are likely to come on stream before 2020 but Brazil will set the benchmark price because of its dominant market position.

It has a strong mandated home market and infrastructure that reduces investment risk. It has built up 30 years of bioethanol production infrastructure, processing expertise and it has vast tracts of land that it is prepared to dedicate to further sugar cane production. It is for these reasons that Brazil has been chosen as the most probable bioethanol supplier for the 2020 scenarios where "least cost" is the main driver.

In 2007/08 Brazil produced 20.3 billion litres of bioethanol of which 3.1 billion litres were exported leaving 17.2 billion litres for home consumption. In 2008/09 home consumption is set to increase by 19% to 20.4 billion litres, production to increase by 4 billion litres and exports reach 3.9 billion litres[50].

PRODUCTIVE CAPACITY

A leading representative of the Brazilian sugar and ethanol industry produced the forecast shown in Table 8: Forecast Brazilian ethanol production, consumption, exports and land area

Brazilian Ethanol (Billion litres)	**2006/07**	**2015/16**	**2025/26**
Domestic consumption (B litre)	14.3	34	88
Export (B litre)	3.2	10	20
Total (B litre)	17.5	44	108
Area (Mha)	2.9	4	6.6

Table 8: Forecast Brazilian ethanol production, consumption, exports and land area[51]

The mid point between the 2015 and 2020 Total ethanol figures are used as the 2020 estimate. The resulting 75 billion litre estimate is not supported by sugar trade sources[52] that indicate 60 billion litres production. The difference is the 15 billion litres of estimated exports. From the same table the 2020 exports should be 15 billion litres and the land area required to produce the sugar cane feedstock would be 5.3 Mha.

COMPETITIVE DEMAND

Internal - The pro-rata Brazilian domestic consumption estimate for 2020 would be 61 billion litres. The high increase in internal demand is occurring as Brazilian motorists change from petrol cars that use the standard 20%-25% bioethanol, to flex fuel vehicles (FFVs) that use hydrous bioethanol.

FFVs first entered the market in 2003. By the beginning of 2008 FFVs made up 90% of new car sales. At the end of 2007 the 4.4 million FFVs represented 20% of all cars on Brazilian roads. The rate of FFV sales is forecast to continue strongly through to 2015 when 19.5 million FFVs would make up 65% of the Brazilian car fleet[53]. If that trend continued then by 2020 it would reach 28.8 million FFVs and 82% of the fleet.

The change in the monthly usage of ethanol can be seen in Figure 18 with the cumulative total for the FFV fleet and petrol sales up to the beginning of 2008.

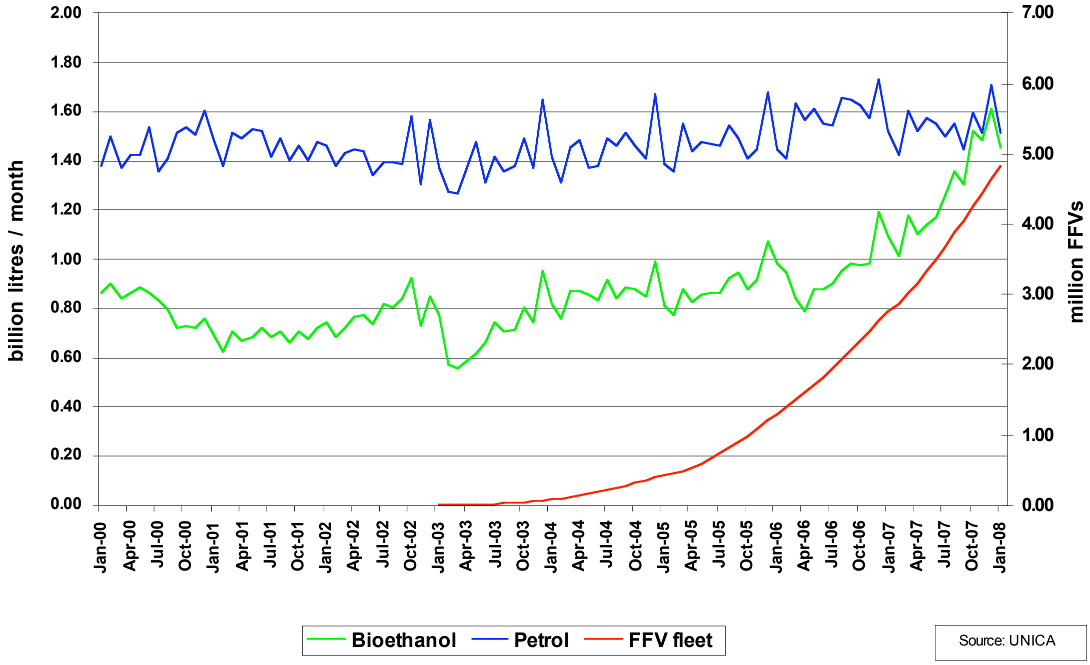


Figure 18: Brazilian monthly bioethanol and petrol sales with the cumulative expansion of the FFV fleet[54]

Sales of bioethanol now match those of petrol in Brazil. Figure 19 shows the UNICA FFV sales trend and extends it to 2020. Assuming that the 25% mandate for standard petrol continues the chart indicates that domestic demand for bioethanol could reach to 60 billion litres - a four fold increase on 2006 demand.

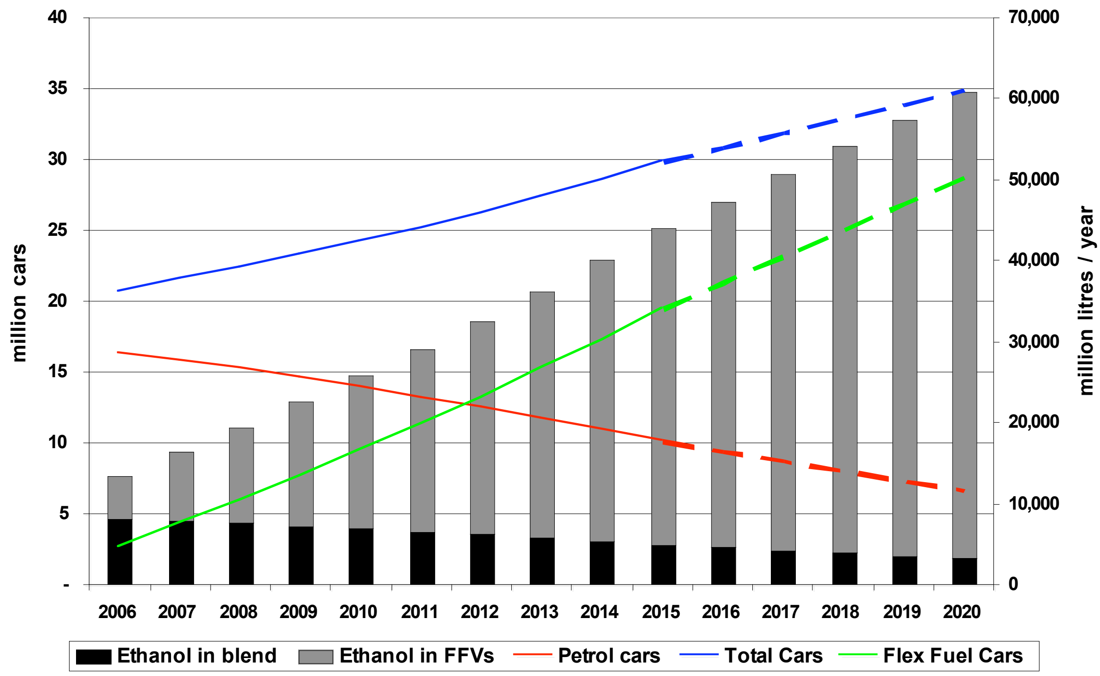


Figure 19: Brazil FFV and bioethanol projections to 2020

Exports - The balance of the bioethanol production remaining after domestic consumption will be exported onto the world market. In 2007 Brazil exported a record 3.5 billion litres that was split between 5 markets - Figure 20. (NB CBI represents the Caribbean Basin Initiative – a programme that permits hydrous ethanol to be imported by approved Caribbean states for dehydration and re-export to the US under a tariff free quota.)

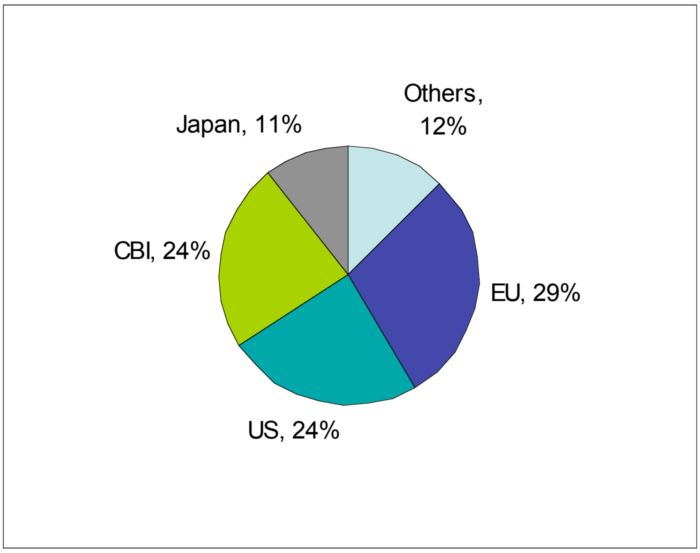


Figure 20: Brazilian ethanol exports 2007

Using the 15 billion export figure forecast by Canaplan – assuming the same pro-rata split between customers - the exports available for Europe would be 4.35 billion litres or 2.6 Mtoe.

Given the widely different production estimates for 2020 from trade sources and the impact of the competitiveness of bioethanol against petrol on internal demand, the scale of Brazilian ethanol exports is uncertain.

This study assumes a practical cap on EU imports to be 3.5 Mtoe made up 2.6 Mtoe from Brazil to and 0.9 Mtoe from developing countries such as the Sugar Protocol countries affected by the reform of the EU sugar regime.

3.2.1.3 The crop yield projections based upon historical performance

Europe's historical rate of cereal growth gives a good indicator of future growth pattern but the actual rate achieved will depend upon the economic incentive, technical achievement, external constraints such as environmental legislation and the weather.

Cereal productivity levels differ between Member States, regions, fields, cereal types and are influenced by changing climatic conditions and economic circumstances. But despite the complexity there are several clear trends that can be identified when using average yields from specified geographical areas.

One is the divergence of productivity trends between the new agricultural Member States and the EU15. This started in the 1970's and became more extreme in the early 1990's - following the break up of the Warsaw pact. Figure 21 shows productivity of the EU15 and the six new member states which are large cereal producers.

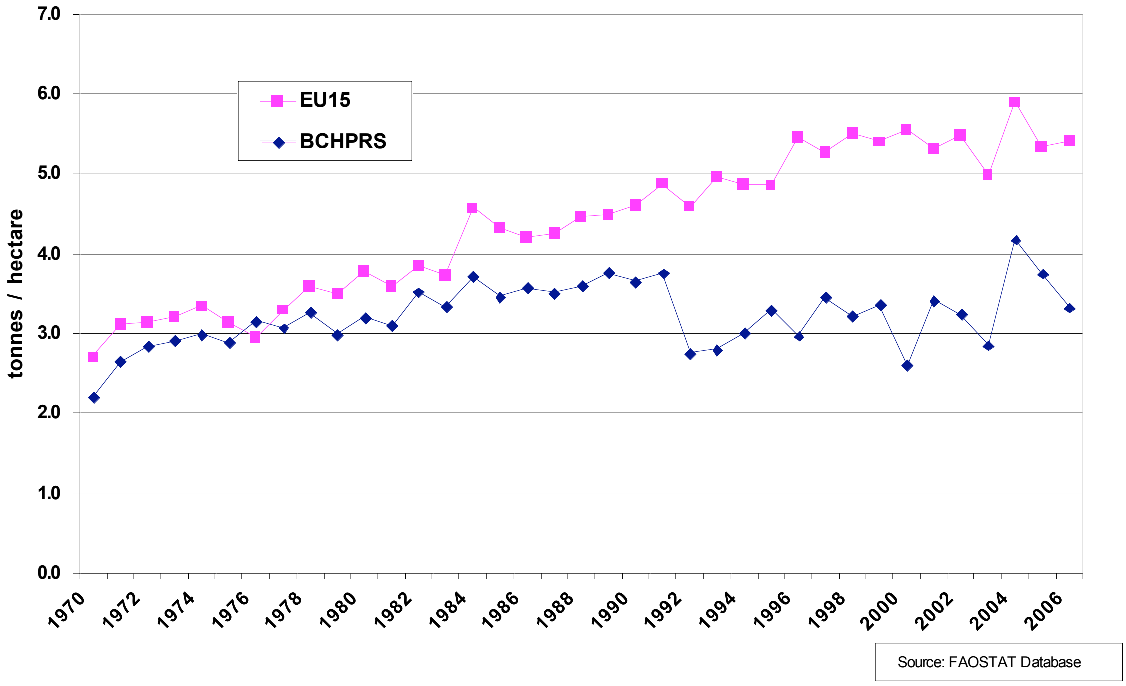


Figure 21: Cereal productivity EU15 & new agricultural member states (Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia)

As there are clear differences in current productivity levels between the EU15 and EU12, that can be largely explained by lack of investment and market access, this study has used differing rates of projected yield increase to allow for a "catch-up" phase that will occur if cereal demand stimulates investment in the EU12. When the market is "demand driven", and therefore prices well above the cost of production, the EU12 improvement in productivity should be 35% higher than in the EU15.

Four projections for crop yield growth in the EU15 have been used in this study - two related to historical trends before and after the McSharry reforms of the CAP, another is the 1% trend proposed by DG AGRI, and a rate that is described as the Sustainable growth trend. This is presumed to be the trend that will result from increased internal demand and a drive for increased crop yields but restrained by the tighter cross compliance rules and the economic constraint caused by high fertiliser prices. The long term cereal yield growth trend (1961 to 2007) is shown to be linear but closer examination shows that since the early 1990's yield growth levelled off.

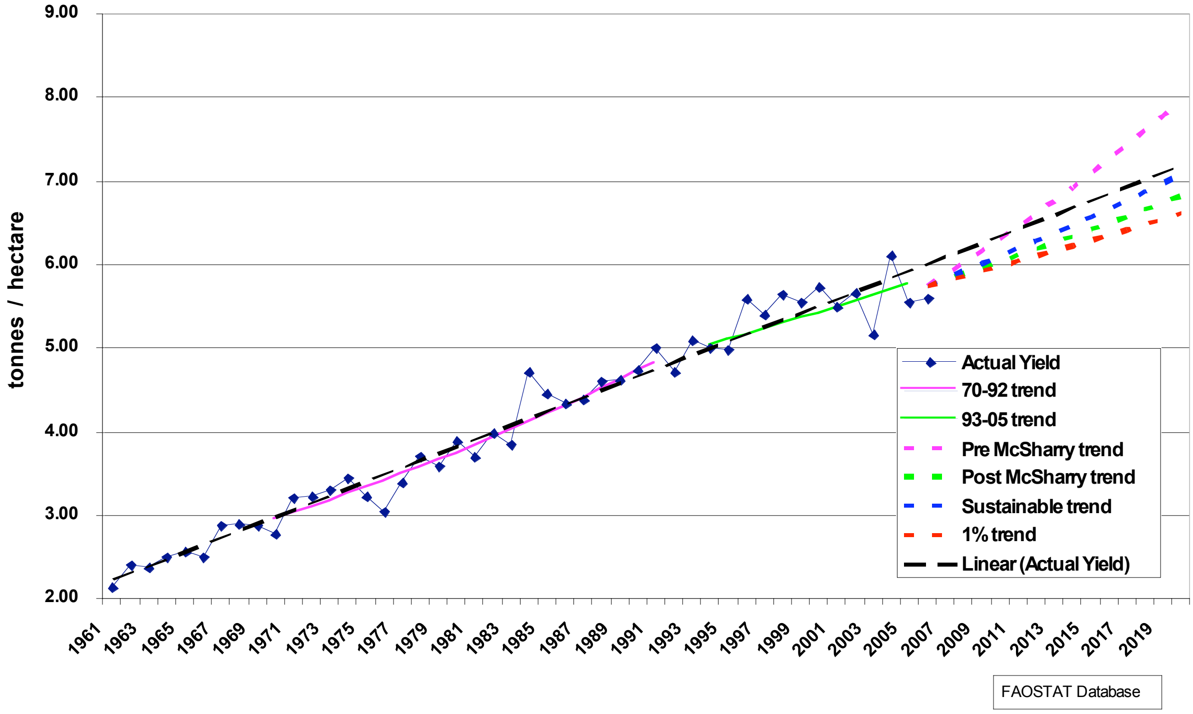


Figure 22: EU15 Cereal yield trends and projections[55]

The four growth rates that have been used in the alternative scenarios are shown in Table 9

	EU15	EU12
DG AGRI	1.00%	1.00%
Pre-McSharry	2.37%.	3.19%
Post-McSharry	1.23%	1.66%
Sustainable	1.50%	2.025%

Table 9: Annual cereal productivity increases used in the scenarios

Further background information on crop yields and the can be found in Annex 4: Notes of EU crop yield growth

3.2.1.4 Process yield rate

Although the existing biofuel technologies are proven, technological innovation and process improvements are continuing to occur throughout the supply chain to obtain more biofuel from the same amount of feedstock.

Bioethanol processes - There are three technological developments for first generation bioethanol that are enabling processors to obtain more ethanol per tonne of cereal feedstock –

1. The development of high starch wheat varieties that provide more sugar per tonne. This is an area of development previously neglected by seed breeders as the premium cereal market have traditionally required high protein and low starch wheat. Even within the current commercial wheat varieties there is a very wide range starch and therefore potential alcohol yield levels. The utilisation of the higher starch varieties already in the market would improve process yields. (see Annex 8: Genetic Reduction in Energy use and Emissions of Nitrogen from cereals)

2. Enzyme technology is developing to improve the efficiency of starch to sugar conversion.

3. The cellulase enzymes, such as xylanase, that are regularly used to reduce viscosity of wheat mash are breaking down part of the hemi-cellulose fraction of the cereal into C5 sugars. But these sugars cannot be converted to alcohol by conventional yeasts. New yeast strains are now being introduced that can utilised these pentosan sugars[56].

Current industry bioethanol yield rates for cereal feedstocks are listed in Table 10

Ethanol yields (Novozymes)	l/t	%
Maize	404	32%
Wheat	375	30%
Barley	335	26%
Rye	360	28%

Table 10: Ethanol yields 2007[57]

Taking the European feedstock weighting, the average yield rate for 2007 is near to 30%. It is assumed that by 2020 current ethanol yields should, because of the developments listed above, increase to 33.33%. This represents an increase in ethanol yield of between 2.86 and 3.03 Mtoe from the same amount of cereal in scenarios D and E.

Biodiesel processes - The main technological development for obtaining more biodiesel from oilseeds will come from increasing the vegetable oil content of the oilseed crop. Seed industry specialists suggest that average oil levels of 46% are within reach that, when processed, should yield about 44% oil. To illustrate the sensitivity of oil extraction levels a 1% increase from 40% to 41% would yield between 0.45 Mtoe and 1.63 Mtoe additional biodiesel in scenarios D and E.

The scenarios use 33.33% yield for bioethanol from cereals and 40% yield for biodiesel from oilseeds.

3.2.1.5 Cap and floor on oilseed area

All of the scenarios with the exception of Max Biodiesel assume that the total cereal and oilseed land area is allocated as in 2006 – 87% cereals and 13% oilseeds. But in Max Biodiesel it has been assumed that oilseeds will be grown to the maximum extent within the rotation.

This is generally assumed to be limited one year in four to prevent the build up of oilseed pests and diseases. It is assumed that there is also a minimum use for oilseeds in the rotation as a "break crop" to prevent the build up of cereal pests and diseases. As oilseeds are structurally uncompetitive[58], in terms of gross margin per hectare, with cereals then it is assumed that the present 13%[59] is the minimum that farmers will fit into the rotation[60].

Oilseed Rape in Rotations

Growing oilseed rape in cereal rotation offers

- *An effective take-all break as an entry to higher-yielding first cereal crops, providing weed control is good*
- *Early drilling and harvesting to spread workload*
- *An opportunity to control grasses, especially herbicide resistant grass weeds*

However, rotation planting should take account of

- *Susceptibility to Sclerotinia which may pose threats to high value crops in the rotation e.g. potatoes*
- *Susceptibility to clubroot which may threaten other brassicas in the rotation*
- *Short rotation, four years or less, which increase the risk of Sclerotinia and clubroot to oilseed rape crops*
- *The seed burden left by oilseed rape which can lead to volunteers for up to ten years*

HGCA Oilseed Rape Growers Guide [60]

3.2.1.6 Non-biofuel cereal demand

According to the Prospects report[61], that provides projects to 2014, the non-biofuel demand for cereals is forecast to be static and the DG AGRI 10% biofuel scenario shows projected cereal demand for food and industrial use for 2020 to be 252.73 Mt - almost identical to the total demand for food, feed and industrial uses in 2014.

The reasons for the static demand for the food and feed sector is explained in the Scenar 2020 report which cites static to falling EU27 population with a higher proportion of older people and, despite increased wealth, there would be no increase in food consumption[62].

"In developed countries food consumption growth is limited. Product and process attributes (food safety, quality, environment, animal welfare, etc.) become more important."

Scenar 2020 [62]

3.2.2 Alternative scenario descriptions A-E

Scenario A - 10% SCENARIO DG TREN RENEWABLE ENERGY ROADMAP SEC (2006) 1721/2

- **Biofuel supply** – 31 Mtoe representing 10% of road transport fuel

- **Technology risk** - This DG Tren scenario assumes that the technologies for producing ethanol from straw, and biodiesel from wood chips and straw, will be commercially viable and in large scale production by 2020. The scale of the new technology dependence is 7.5 Mtoe or almost a quarter of the EU 2020 minimum 10% target.

- **Biofuel import dependence** - The scenario relies upon the importation of 0.3 Mtoe of sugar cane ethanol and 5 Mtoe of a range of vegetable oilseeds and oils - an import dependence of 17%.

- **Land** - There is no increase in arable area but 53% of set aside land, 3.8 Mha, is expected to come back into production of cereals and oilseeds. Reduction in land areas required for sugar beet (-0.5 Mha) and "other crops" (-0.3 Mha) will be balanced by increase in cereals and oilseed area. Land allocation between cereals and oilseeds is expected to remain near to current ratio of 87:13.

- **Productivity** - It assumes a low cereal productivity growth, 1% per annum, which is even less than the average attained in the low cereal demand and low price period following the McSharry reforms. It should be noted that the starting yield for the growth trend is lower than the five year or three year averages up to 2006 and so production may be understated.

- **Cereal Exports** - Despite the modest cereal productivity growth, and the low starting yield, there is still a 6.9 Mt cereal surplus for export after supplying the food, feed and other industrial uses as well as 61 Mt for bioethanol.

- **Other EU Feedstocks** - Sugar beet and oilseeds are forecast to maintain 2% annual yield growth rates up to 2020.

- **Fuel Split** - This scenario produces a 61:39 split between bioethanol (18.8 Mtoe) and biodiesel (12.2 Mtoe). If the bioethanol was only used to replace petrol it would displace more than 13% of the fossil fuel and if biodiesel was only used in diesel it would displace 7%.

Scenario B - NO BIOFUELS SCENARIO

- **Fuel supply** - This scenario assumes no EU biofuel consumption or production.

- **Land** -Idle land is increased to 10.8 Mha as cereal and oilseed land is abandoned[63].

- **Productivity** - Cereal yield increases restrained to the 1% rate as used in Scenario A.

- **Cereal Exports** - The large cereal surplus of 85Mt after providing for domestic demand for food, feed and other industrial use will need to be exported to clear the market.

Scenarios C & D - COMMON ASSUMPTIONS

- **Ethanol yield** – it is assumed that by 2020 current average ethanol yields of near 30% w/w from maize, wheat, barley and rye should increase by 10% to 33% because of the development of higher starch cereals and the use of more efficient conversion technologies.

- **Only first generation biofuels are used** - Advanced biofuel technologies, such as ligno-cellulosic ethanol and BTL, will need to be scaled up from the current pilot projects and then overcome new obstacles that will inevitably occur before they can provide any significant quantities of biofuels. The developers will need to discover and exploit "technical breakthroughs" - the timing of which are notoriously difficult to forecast[64].

> *"Even if targeted high subsidies result in the construction of several full-size plants by 2020, the learning will not have an effect until after 2020. Therefore 2nd generation biofuels will be still much more expensive even than 1st generation ones in 2020"*
>
> ***EU JRC 2008*64**

- **Imports** - Neither biofuels nor their feedstocks will be imported.

- **Productivity potential for cereals** - These yields are achieved using nitrogen fertiliser application rates that are compatible with Cross Compliance and Environmental Regulations for Nitrate Vulnerable Zones (NVZs). The average yields will increase because of
  - a shift from lower yielding crops such as barley, oats and rye to higher yielding wheat and maize – where the climate and soil types permit
  - improved cereal seed – especially the high starch / high yielding wheat varieties that require less nitrogen than high protein cereals.
  - higher costs for Nitrogen will lead to better targeting of fertiliser - especially with the roll-out of precision farming methods as ICT (Information Communications Technology) costs reduce. Precision application of N will ensure that the all of the crop receives the required nutrients for growth with less fertiliser usage and the associated problems of leaching and eutrophication.
  - investment in agricultural infrastructure in the new member states that will remove some of the market access barriers, and lower the distribution costs, that have restricted crop production in some of these states.
  - application of more advanced agronomy in the new agricultural member states where, on average, cereal yields lag behind the EU15 by 2 tonnes per hectare.

- **Idle land** – 50% of idle land brought back into crop production coming mainly from former rotational set-aside. The remainder, mainly in field margins and alongside water courses, is expected to be left idle to comply with cross compliance and conservation measures.

- **Other Cereal Demand** - All long term predictions of demand for cereal in food, feed and other industrial sectors are static.

- **Sugar beet** - The bioethanol production from sugar beet is taken from DG-AGRI's 10% scenario.

- **DDGS Substitution**[65] - All DDGS is sold in Europe - 20% of which is estimated to substitute for cereal use in animal feeds – reducing the area needed for feed grain production. That grain is then made available for bioethanol production. The balance of the DDGS will substitute for imported protein feed ingredients such as maize gluten and soybean. The exact feed substitution mix between protein and energy ingredients will depend upon price relationships and availability at the time of use.

Scenario C - MAXIMISATION OF EU BIODIESEL

- **Grain prices** – This scenario assumes strong demand for both cereals and oilseeds but that oilseed prices rise more that cereal prices so that farmers maximise the area of oilseed planting. The strong demand for cereals will continue to incentivise farmers to maximise productivity but the 29Mt cereal surplus will cause prices to be capped by world market.
- **Productivity** - The near doubling of oilseed area, compared with other scenarios, provides 71Mt of oilseeds of which 47 Mt would be used for biofuels. The productivity of cereals in the EU15 will be at the Pre McSharry rate of 2.37% per annum. For the EU12, the assumed productivity increase of 3.19% per annum is taken from the historic average of the then 4 poorest Member States of the EU (Ireland, Portugal, Spain and Greece) from their accession until the McSharry reforms. But the EU27 area of cereals planted will reduce by 8.7 Mha (13.8%) compared to scenario (A).
- **Crop Allocations** – The ratio of cereals to oilseeds shifts to the maximum sustainable oilseed rotation of one year in four - a ratio of 75:25.
- **Fuel Split** - This scenario produces a 63:37 split between bioethanol (27.2 Mtoe) and biodiesel (16.7 Mtoe). If the bioethanol was only used to replace petrol it would displace more than 19% of the fossil fuel and if biodiesel was only used in diesel it would displace 10%.

Scenario D – SUSTAINABLE YIELD GROWTH

- **Grain prices** – This scenario assumes prices are in excess of the cost of production, providing sufficient reward for growers to optimise profitability by targeting inputs to provide cost efficient yield increases. Levels would be capped by world prices but the exports of 29 Mt indicate a price of €125.32 / tonne – a 1% increase compared to the 2006 benchmark[66].
- **Productivity** – Productivity levels in the EU15 are projected to continue at a slightly higher level than recently at 1.5% that reflects the continued restraint on fertiliser inputs because of cost and environmental compliance but still benefiting from improved seed varieties, agronomy and a shift in the cereal mix towards higher yielding cereal types such as wheat and maize. EU12 productivity is expected to increase at 35% higher than the EU15 at 2.03% per annum.
- **Crop Allocations** – The ratio of cereals to oilseeds remains at the average ratio of 87:13.
- **Fuel Split** - This scenario produces a 85:15 split between bioethanol (25.8 Mtoe) and biodiesel (4.5 Mtoe). If the bioethanol was only used to replace petrol it would displace more than 18% of the fossil fuel and if biodiesel was only used in diesel it would displace 2.6%.

Scenario E - All biofuel imports to meet 10% biofuel target

- **Fuel Split** - will be to suit the forecast market for 14 Mtoe of bioethanol and 17 Mt of biodiesel to match the 45:55 ratio as forecast by DG Tren

- All other factors are the same as Scenario 2

3.2.3 Alternative Scenario details

		A	B	C	D	E
Biofuel Consumption		**DG Tren 10%**	**No Biofuel**	**Max Biodiesel**	**Sustainable Yield**	**All imports**
Ethanol from cereals	Mtoe	12.7	0.0	27.2	25.8	0.0
Ethanol from sugar beet	Mtoe	0.8	0.0	0.8	0.8	0.0
Biodiesel from oilseeds	Mtoe	4.7	0.0	16.7	4.5	0.0
Bioethanol from straw	Mtoe	5.0	0.0	0.0	0.0	0.0
BTL	Mtoe	2.5	0.0	0.0	0.0	0.0
Bioethanol imports	Mtoe	0.3	0.0	0.0	0.0	14.0
Biodiesel & feedstock imports	Mtoe	5.0	0.0	0.0	0.0	17.1
TOTAL BIOFUELS	Mtoe	31.0	0.0	44.7	31.2	31.0
Forecast transport fuel demand - 2020	Mtoe	310.0	310.0	310.0	310.0	310.0
BIOFUEL %	**%**	10%	0%	14%	10%	10%

Table 11: Biofuel consumption and sources for alternative scenarios

Cereal situation (Mt)	A	B	C	D	E
	DG Tren 10%	No Biofuel	Max Biodiesel	Sustainable Yield	All imports
Production	309.6	326.7	389.2	396.3	326.7
Non-biofuel demand	252.7	252.7	252.7	252.7	252.7
Use for biofuels	60.9	0.0	118.4	112.5	0.0
Exports	6.9	84.9	29.0	42.0	84.9
Imports	10.9	10.9	10.9	10.9	10.9

Table 12: Cereal situation for 2020 under alternative scenarios

LAND Allocation 2020		**DG Tren 10%**	**No Biofuel**	**Max Biodiesel**	**Sustainable Yield**	**All imports**
Cereal area	Mha	62.8	56.5	54.1	62.8	56.5
Oilseed area	Mha	9.6	8.4	18.0	9.4	8.4
Arable land in EU15	Mha	72.4	65.0	72.2	72.2	65.0
Sugar beet area 2020	Mha	1.4	1.4	1.4	1.4	1.4
Idle land	Mha	3.4	10.8	3.6	3.6	10.8
Other crops	Mha	36.6	36.6	36.6	36.6	36.6
Total arable area	Mha	113.8	113.8	113.8	113.8	113.8

Table 13: Arable land use 2020 under scenarios

LAND USE CHANGE FOR 2020		A	B	C	D	E
Cereal area change	Mha	3.8	-2.5	-4.9	3.8	-2.5
Oilseed area change	Mha	0.8	-0.4	9.2	0.6	-0.4
Total cereal & oilseed area change	Mha	4.6	-2.8	4.4	4.4	-2.8
Sugar beet area change	Mha	-0.5	-0.5	-0.5	-0.5	-0.5
Idle land change	Mha	-3.8	3.6	-3.6	-3.6	3.6
Total other crops change	Mha	-0.3	-0.3	-0.3	-0.3	-0.3
Total arable area change	Mha	0.0	0.0	0.0	0.0	0.0

Table 14: Land use changes by 2020 under scenarios

	A	B	C	D	E
EU27 Cereal Yield	4.93	5.78	7.19	6.31	5.78
Price based upon exports	130.74	111.62	125.32	122.14	111.62
Earnings per hectare	644.25	645.20	901.16	770.97	645.20

Table 15: Cereal yield, notional price and earnings per hectare

A summary table of the alternative scenarios can be found in Annex 6: Details of alternative scenarios

4 Impacts of alternative 2020 Biofuel scenarios on Europe's future food prices and food security

The impacts of the EU's 2020 Biofuel policy on food prices and food security will depend upon the scale of cereal demand and cereal production and the resulting level of surplus or deficit both within Europe and in the world cereal market.

The price impacts of the Commission's scenarios are shown in Table 16

Commodity	Average price 2006 (€/t)	Price change relative to 2006 average		
		Scenario		
		no biofuel	7%	14%
Wheat	124	114 (-8%)	123 (-1%)	131 (+6%)
Soy meal	170	202 (+19%)	119 (-30%)	104 (-39%)
Crude oil	change relative to no biofuel use:		-1.5%	-3%

Table 16: Important price effects of biofuel promotion[67]

The large scale use of cereals for bioethanol influences grain and food prices over different time frames and it also influences the economics of grain production.

The supply of high protein feed ingredients from the bioethanol industry has an impact on animal feed prices and ultimately the cost of consumer meat products.

The supply of bioethanol has an impact on fuel prices that affect most stages of the grain and food supply chain.

4.1 Grain price, cost and supply impacts

Price and supply impacts

- Short term (within the grain marketing year)
- Medium term (the planting and growing season)
- Long term (multi-year)

Short term impacts – Within a grain marketing year, between harvests, the amount of cereals used for bioethanol will depend upon its price competitiveness with other biofuels or fossil fuels. This makes cereal demand for bioethanol elastic[68] whereas classically economists recognise that cereal demand for food is inelastic. Feed usage of cereals is more elastic than food because some other non-cereal feedstuffs can be utilised.

The impact of large scale usage of cereals for biofuels within a marketing year is to

- **support prices at times of oversupply** - by using more cereals for bioethanol when grain production is surplus to food, feed and the forecast bioethanol requirements and prices have fallen. Improving the process margins for the bioethanol producers – creating a price floor for the growers.
- **depress prices when supplies are short** – by reducing cereal consumption for bioethanol when the grain market is in short supply and prices have risen. It would be uneconomic to use cereals for bioethanol so that there would be a price ceiling established for the food and feed sector.

Thus within the marketing year bioethanol has the effect of creating a floor and a ceiling to cereal prices. Examples of this effect on the US maize and Thai Cassava were cited by Schmidhuber.[69]

In periods when the grain is in short supply the prices will rise but the inelastic food market will continue to take what it needs, the feed sector will substitute other commodities to reduce its demand. However cereal consumption for bioethanol will be trimmed once it becomes uneconomic and the processors will shift to other feedstocks, if the plant design allows. Alternatively they will reduce plant utilisation or even put the plants into "mothballs" until process margins can be restored.

The cereal production for bioethanol effectively acts as a buffer stock that can be drawn down when the food and feed markets are short and prices rise. The supply response would be immediate as it is simply the reallocation of stock.

This flexibility of allocation will not be available if forecast cereal demand for bioethanol was low and farmers responded by planting a crop that was expected to just satisfy the food and feed market. If weather problems caused the harvest to be smaller than was required then prices would rise. The higher prices would stimulate more crop production but there would be no new supplies available for between one to two years[70].

Medium term impacts

The most important medium term factor is the amount of land that farmers allocated to particular crops at planting time. Their planting decisions are influenced by their confidence that they can obtain a return on their variable costs – seed, labour, fertiliser, fuel and other agrochemicals. They will monitor the forward prices for the "new crop" at the time of planting.

The prospect of large demand for the three principal cereal market sectors and the knowledge that there will be no excessive carry-over stocks will sustain forward prices and provide confidence to invest in planting the crops and to aim for optimum yields.

There is a very high probability that the growers' planting and productivity response will be to produce a harvest surplus above food and feed demand – even in years when adverse weather has reduced crop yields. Indeed under all scenarios considered in this study all EU demand for food, feed and fuel will be supplied and still leave a surplus that will need to be exported.

Long term impacts

Reduced price volatility and the knowledge that the market will clear reduce risks and stimulates investment and innovation.

- Growers (and governments) invest in agricultural infrastructure and technology
- Seed developers invest in R&D to provide new cereal varieties that provide better yields, improved disease resistance or other characteristics such as drought tolerance
- Researchers to develop new agronomic techniques to improve productivity
- Technology providers to further develop precision farming equipment that allows growers to target farm inputs - such as fertiliser

All of these developments lead to greater productivity and lower unit costs. In turn the lower break-even level allows growers to withstand lower crop prices. This is the long term agricultural trend that has provided falling real prices for consumers for generations as illustrated in Figure 23: Real food prices 1960 - 2005.

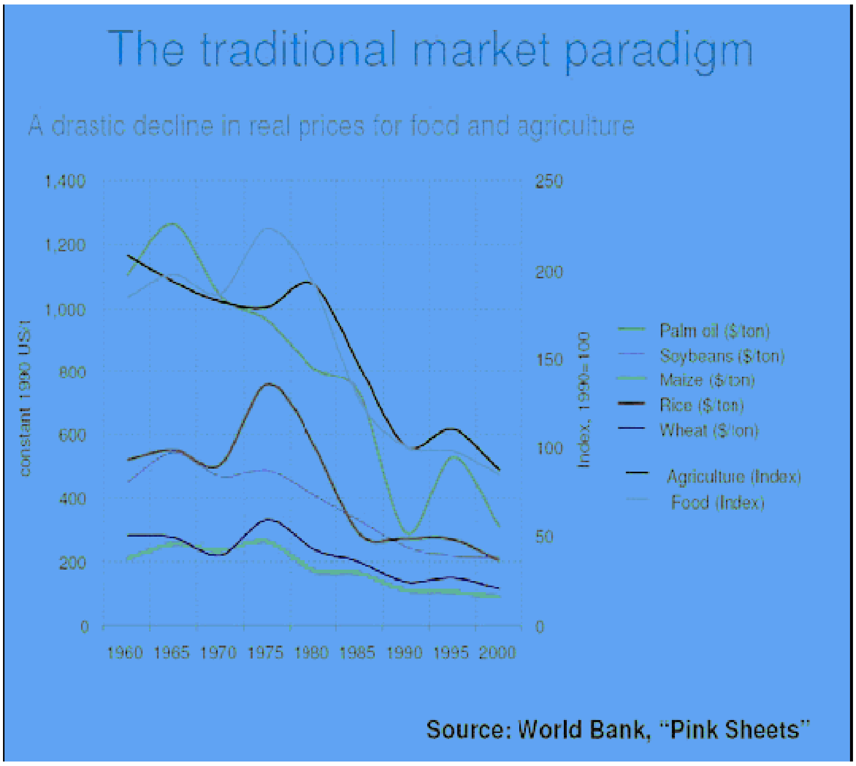


Figure 23: Real food prices 1960 - 2005[71]

Fertiliser costs - An estimate of average cereal production costs in major grain growing nations was presented by the HGCA to the UK government in April 2008[72]. It showed that between 2003 and 2008 all variable costs had risen, as would be expected, in US$ terms but more significant was the increase in sensitivity to the cost of nitrogen fertiliser, which is closely linked to the cost of energy. In early 2008 it represented 49% of the cereal growers' variable costs. This illustrates how vulnerable the cost of basic food production is becoming to the movement in energy prices.

Variable costs	2003/04		2007/08	
Seed	9.8	19%	13.1	16%
Fertiliser	19.4	39%	38.9	49%
Protection	15.6	31%	20.8	26%
Contracting	5.5	11%	7.3	9%
Total Variable cost	**50.3**		**80.1**	

Table 17: Average cereal production costs (Estimated Average for France, UK, Canada, USA, Australia, Ukraine, Kazakhstan. Excludes rent and mortgage charges)

4.2 Feed price and supply impacts

The EU annually produces 450 Mt of animal feed mainly using 160 Mt of domestically produced cereals, food industry co-products such as wheatfeed from flour milling, beet pulp pellets from sugar processors are high protein oilseed meals from EU based seed crushers. In addition 37 Mt of ingredients are imported annually 80% of which are high protein oilmeals. Soybean meal imports from Argentina and

Brazil amount to over 25 Mt per annum. Corn gluten feed, a co-product from the US wet milling industry, was one of the main import ingredients, circa 4 Mt in 2002 but in 2007 it had reduced to 700kt.

The production of high protein DDGS by the bioethanol industry will reduce Europe's dependence upon imported protein and as it will have to compete with the imported material prices will fall relative to the business as usual situation. Figure 24 shows the scenario range from zero DDGS availability to 42.5 Mt per annum.

	Scenarios				
	A	B	C	D	E
DDGS Production (Mt)	21.5	0.0	42.5	40.4	0.0

Figure 24: DDGS production under the five alternative scenarios

The zero scenarios would preserve the status quo where Europe is competing in the world market to buy important protein ingredients and it will continue to be dependent upon nations that may decide to restrict supplies as happened with the USA in the 1970s and more recently with the imposition of export taxes and the subsequent farmers strikes in Argentina in 2008.

The large scale DDGS production in A, C and D would suggest an oversupply of the co-product but DDGS is not simply a high protein ingredient – it has a high energy content when used in ruminant diets. Its impact will be to displace feed ingredients in the following order

1. Imported Corn Gluten feed (700kt) and DDGS (400kt)
2. The small soya fraction that is currently used in cattle feed.
3. A proportion of the soya that is currently used in pig and poultry diets
4. The balance to replace cereals in cattle feed diets – this will be partly due to the displacement of cereals grown and used "on-farm" by industrial feed that will include DDGS. The cereals would be then sold on the open market because cereal prices will be relatively higher than the compounds and straights.

The result will be to reduce the cost of protein feed ingredients for livestock producers and a tempering of grain prices as more cereals are replaced by industrial feeds.

4.3 EU Food prices

As indicated in 2.2, within Europe the cereal component in the consumer price of food is often less than 5% and on average no greater than 20%. sThe remaining 80% to 95% of food costs relate to distribution, processing, packaging and marketing.

Therefore food prices are more sensitive to the movement of other costs than for the cereal component. Distribution, processing and packaging are very sensitive to oil costs because of transportation, process energy and oil based chemicals used for packaging.

An index of grain price movements from January 1998 to May 2008 is illustrated in Figure 25 alongside the index for crude oil prices. It will be noted that whilst cereal prices increased by up to 200% oil prices rose by 600%.

According to a report by the Federal Reserve Bank of Kansas City, "a 10% gain in energy prices could contribute 5.2% to retail food prices". If this oil to food cost relationship is applicable in Europe it suggests that energy cost has between 2.5 and 10 times the impact of cereal cost on the price of food in a developed country.

Energy costs along the supply chain are not readily available but it is reasonable to conclude that the 600% increase in crude oil prices since the beginning of January 1998 and Mid May 2008 has had a greater impact on food prices than cereals which have risen by less than 200%.

The impact on future prices will be more significant as energy is becoming a larger component in the cost make up of food. The sensitivity of food prices to energy costs is increasing as the sensitivity of the basic grain component is falling.

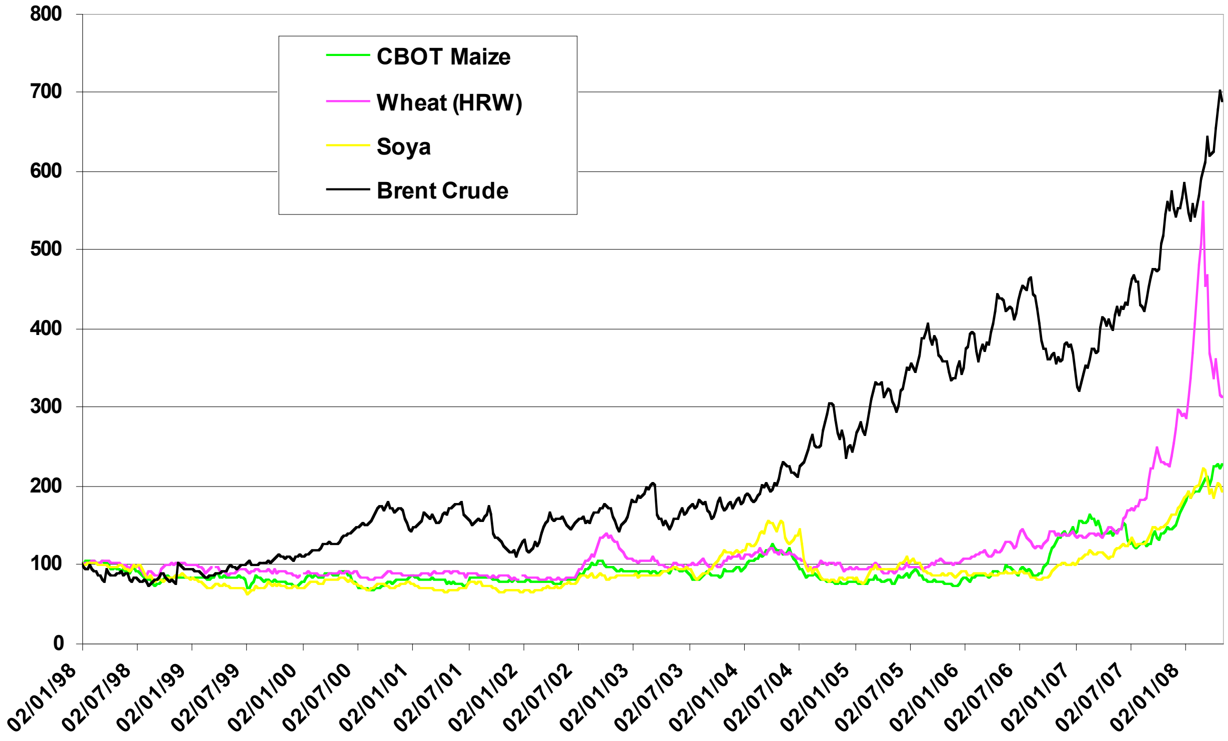


Figure 25: Commodity price indices from crude oil and CBOT cereals Jan 2006 t0 May 2008)

4.4 Oil supplies, biofuels and food costs

At the beginning of 2008 rising world oil demand is outstripping OPEC's ability, or willingness, to supply. The non-OPEC suppliers are also failing to increase output.

"The severity of non-OPEC supply weakness stands out as a primary factor behind the strong run-up in prices through the year so far," Barclays Capital said in a research note.

The failure of non-OPEC producers to increase output significantly has also sent long-term prices even higher, at close to $150 a barrel.

Reuters May 23, 2008

The shortage of supply and limited refining capacity are forcing up oil prices and affecting costs all along the food supply chain through agriculture, distribution, processing and packaging.

The biofuel sector is creating more fuel supply through its own biorefinery network. At the beginning of 2008 it was reported by the International Energy Agency

"To replace the global supply of ethanol and biodiesel-based biofuels added to the U.S. and European markets since 2005 would require an additional 1 million barrels of crude oil to be processed per day" …"It is sobering to realize the amount of oil that would be needed to replace them,"[73]

'Without biofuels, which can be refined to produce fuels much like the ones made from petroleum, oil prices would be even higher. Merrill Lynch commodity strategist Francisco Blanch says that oil and gasoline prices would be about 15% higher if biofuel producers weren't increasing their output.'

Wall Street Journal March 24th 2008

The impact of this scale of new fuel supply on the price of oil was estimated by Merrill Lynch to be dampening the rises in crude oil prices[74].

On this basis, using the oil to food cost relationship estimate from the Reserve Bank of Kansas, a 15% dampening of oil prices should lead to 7.8% dampening of food prices.

The ability of the European bioethanol industry to dampen oil prices and reduce their impact on food costs is currently limited by the 5% blending limit for ethanol in petrol, the limited number of FFVs and the lack of E85 distribution structure.

The bioethanol production from 2020 scenarios C and D, 27.2 Mtoe and 25.8 Mtoe, would not be able to be utilised within Europe unless the market is expanded by a greater utilisation of FFVs or an increase in the blending limit.

The projection for 2020 in 3.2.1.1 suggests a cap at 20.8 Mtoe with FFVs representing 8.6% of the total car fleet and other petrol cars using 10% bioethanol blends. The EU ethanol consumption level would reach 27.5 Mtoe if 40% of the cars were FFVs using E85 for 80% of the time. Alternatively 27.9 Mtoe could be achieved if all petrol cars could use a 20% bioethanol blend.

4.5 Impact of 2020 biofuel scenarios of EU cereal prices

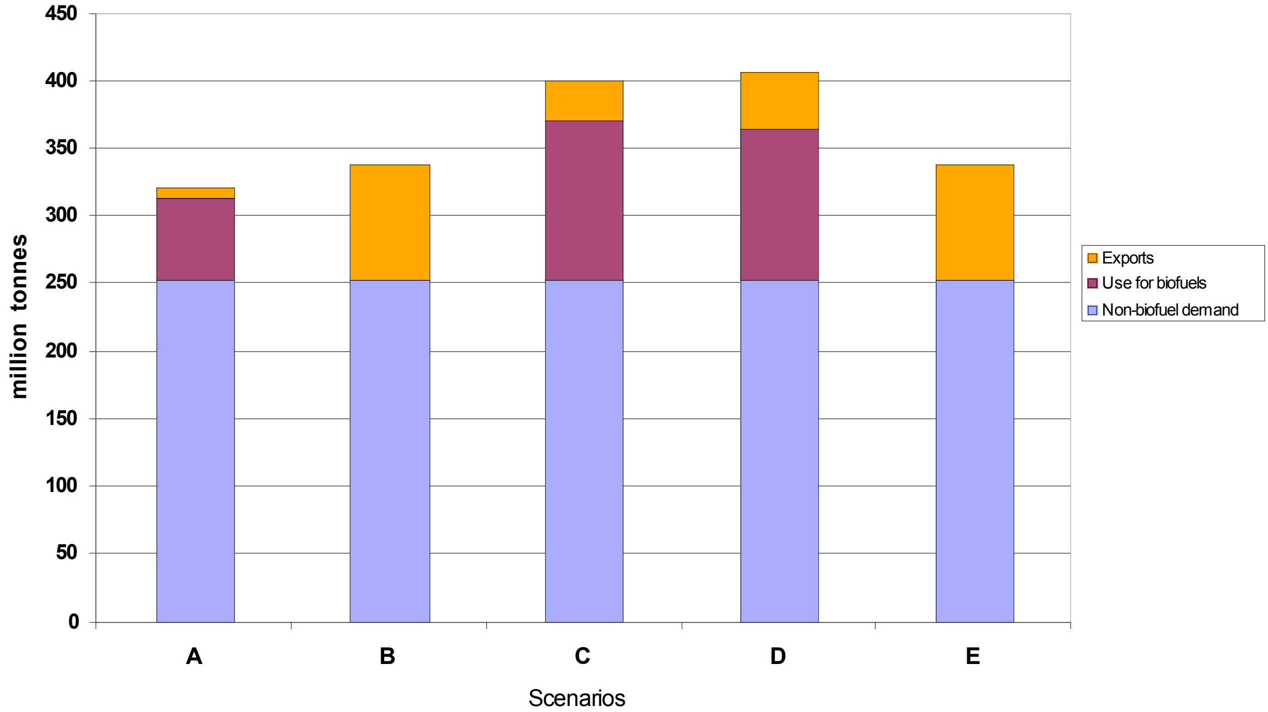


Figure 26: Cereal usage under the alternative scenarios

Scenario Key

A	B	C	D	E
DG TREN 10% target from Biofuel Progress Report	Zero Biofuels target	Max EU biodiesel production from EU feedstocks	10% target from EU feedstocks, productivity restrained by environmental restrictions	10% target supplied by imports only

Under all scenarios EU cereal production exceeds food, feed and other industrial demand by between 60 Mt and 150 Mt depending upon the scale of productivity increase. And, if there was no internal consumption for other purposes, this surplus would need to be sold into the world market to bring the internal market back into balance.

In these scenarios it is the scale of oversupply, the exportable surplus, which will determine the internal prices in relation to the world market. An under-supplied EU cereal market would switch the price structure from Export Parity to Import Parity[75] and raise the price of all cereals by the cost of freight for imports until a new equilibrium is achieved by reducing demand or increasing imports. But very large surpluses will also have a dampening impact on world prices. This means that internal prices suffer a double blow when the exportable surpluses are very high – the internal prices are based upon export parity so that they are at world price levels but then the EU surplus would itself push down that world market price.

EU exports in excess of 29 Mt per annum, according to DG AGRI's formula32, are judged to have a negative impact on internal prices compared to 2006 levels. And conversely a smaller surplus than 29 Mt tends to support internal prices.

Comments on Scenarios

These scenarios are used to represent what would happen under differing circumstances but as we are dealing with dynamic markets there are always market responses that tend to modulate the supply to suit perceived demand. So the comments cover the static impacts in 2020 and the likely longer term impacts.

Scenario (A) DG Tren 10% - understates the productive capacity of European agriculture by using a low starting yield for cereal crops and a historically low yield improvement trend. So that after 14 years of technological development, improved infrastructure and agronomy in the EU10, and more than half of the idle land brought back into production the 2020 harvest is projected to be 11 Mt less than that of 2004[76].

If Europe only managed to produce the projected 310 Mt of cereals in this scenario by 2020 the impact would be to create a 17% biofuel import dependency and create a (24%) reliance on technology that is still to be proven in commercial scale operations.

The forecast impact on grain prices by 2020 of this scenario, compared to the 2006 average, is a 6% rise to €131 / tonne when using the chart in Table 5 of the Biofuel Progress Report that shows an inverse relationship with the scale of exports.

Adding 31 Mtoe of biofuel to the world oil market will tend to reduce oil prices and ease the pressure ofn food production costs.

Scenario B – No Biofuels

The cereal surplus of 85 Mt based upon the Post McSharry growth rate, would imply a cereal price fall of 9.7% to €112 / tonne. This level will be below the cost of production for many growers and thus create pressure to reduce production and abandon land. This will increase poverty in the least efficient cereal areas.

According to Scenar 2020[62] an unprofitable agricultural sector is expected to encourage further migration from the rural areas along the eastern border regions of the EU27. It suggests that the migrants are more likely to seek employment in the prosperous cities of Western Europe than to cities within their own nation.

Scenario C – Maximum Biodiesel

This scenario would occur if the comparative price of oilseeds increased in relation to cereals to an extent that farmers planted the maximum area of oilseeds that could fit into an economic and sustainable crop rotation. The high rates of cereal productivity growth would still allow for 27.2 Mtoe of bioethanol production and leave 29 Mt of cereals for export. In this scenario grain prices would be similar to 2006 levels.

Adding 45 Mtoe of biofuel to the world oil market will tend to reduce oil prices and ease the pressure on food production costs.

Scenario D – 10% Biofuels from Sustainable yield growth

This scenario shows how the EU can achieve the 10% biofuel target of 31 Mtoe from EU feedstocks using proven biofuel technology without creating significant land use changes and avoiding excessive use of Nitrogen fertiliser.

Adding 31 Mtoe of biofuel to the world oil market will tend to reduce oil prices and ease the pressure on food production costs.

Scenario E – 10% biofuel target fulfilled by all imports

Like scenario B grain prices would initially be very low because of the large cereal surplus. Subsequently it would lead to reduced production and rising grain prices.

More significantly it would put Europe into direct competition for 31 Mtoe of biofuels derived from agricultural products in other parts of the world. This scenario would increase pressure for land use change in the developing world. It would miss the opportunity to add 31 Mt of internally sourced fuel to the world market, equivalent to about 3 days world oil supply, to put downward pressure on oil prices with the subsequent benefit of reducing food production costs.

Cereal Impact Summary					
	Cereal use (Mt)		Short to medium term		Long term impacts
	Ethanol	Exports	Prices	Supply	
A	61	7	Tending to be higher but capped if prices become uncompetitive for ethanol	Low export level leaving little margin for error if there was a poor harvest. But in that event cereals would tend to be reallocated as ethanol production eased	If the crop yield trend is above 1% per annum the crop surpluses and exports will be higher so that downward pressure would be maintained on prices in line with productivity gains.
B	0	85	Very low prices with exports being the only route to clear the market	Oversupply 85Mt exports	Low grain prices and no floor to the market would disincentivise cereal production and lead to supply and price volatility in subsequent years. Lower investment in agriculture and eventually a contraction of EU cereal production.
C	118	29	Stable prices because of moderate exportable surplus	Balanced Market	Prices will fluctuate from season to season based upon the harvest turnout and world market prices. But the large supply base would ensure that the EU would usually be oversupplied and the floor / ceiling effect will keep supply and prices within a range.
D	113	42	Lower prices because of exportable surplus but the low prices would stimulate extra demand for biofuel use and reduce the exports. Providing a floor to the market	Oversupply but extra could be absorbed by the ethanol sector	Prices will fluctuate from season to season based upon the harvest turnout and world market prices. But the large supply base would ensure that the EU would usually be oversupplied and the floor / ceiling effect will keep supply and prices within a range.
E	0	85	Very low prices	Oversupply 85Mt exports	Low grain prices with no floor to the market disincentivise cereal production and leads to supply and price volatility and eventually a contraction of EU cereal production.

Table 18: Summary of scenario impacts on grain prices and production

Conclusion

The forecasts made by the Commission have been built upon prudent assumptions that, even when applying their "methodological conservatism" approach, demonstrate there will be ample cereals produced within Europe to satisfy the requirements for food, feed and bioethanol.

Historical performance demonstrates that given the right economic circumstances, EU farmers have the expertise and the land area to steadily continue the long-term agricultural trend of increasing cereal production at a competitive cost.

A growing cereal demand for bioethanol underpins EU agricultural investment that improves productivity and helps to reduce poverty in the rural areas of the new Member States. The productivity increases are necessary to restrain cereal prices for all consumers whilst providing suitable incentives for farmers to grow the crops. Under these circumstances Europe will maintain a very high level of food security without causing significant adverse impacts on EU food prices.

5 Impact of EU 2020 biofuel policy on poverty in the developing nations

Critics of biofuels claimed that using food crops caused hunger in the developing world. This is despite many statements from aid agencies and government bodies that state there is enough food in the world to feed every person on the planet.

It is universally recognised that the cause of hunger is poverty. International development bodies and aid agencies acknowledge that the world produces enough food to comfortably feed all of its inhabitants and that the main cause of hunger is not shortage of food but lack of physical and economic access to food.[77]

> *"Our planet produces enough food to feed the entire planet. But tonight 854 million men, women and children will go to sleep on an empty stomach."*
>
> **Jacques Diouf Director General (FAO) on World Food Day Oct 2007**

The impact of the 2020 EU biofuel scenarios on poverty in the developing world will relate to changes caused to world market prices for food crops and crude oil.

Competition for food crops – change in net export/import balance of cereals

Competition for fuel – change in net imports of oil

5.1 Agriculture is the best economic driver for poverty reduction

Agriculture is described by the World Bank as having "special powers" in reducing poverty across all country types and this is particularly true for the agriculture-based economies[78]. Growth in the agricultural sector is at least twice as effective as in reducing poverty as growth in the non-agricultural sector. In China agricultural growth is up to 3.5 times and in Latin America 2.7 times more effective than growth in other sectors at reducing poverty.

Part of the reason that it is so effective in reducing poverty is that more than 70% of the people in poverty make their living in the rural economy. Figure 27 illustrates the proportion of the population in LDCs who are dependent upon agriculture.

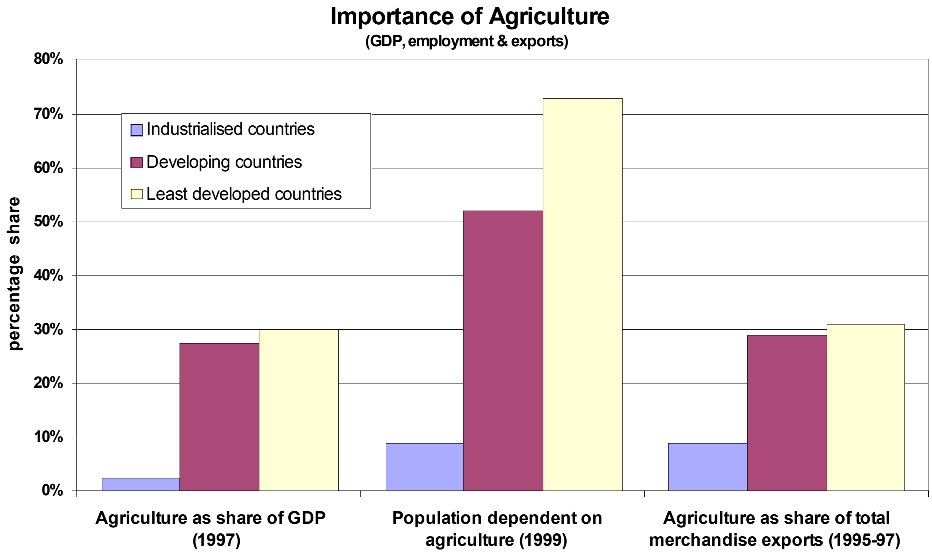


Figure 27: Importance of Agriculture[79]

> *"What history shows! Higher agricultural productivity generating an agricultural surplus, taxed to finance industrial development, and enabling lower food prices underpinned early development in Western Europe, the United States, and Japan, and later in Taiwan, China, and the Republic of Korea. More recently, rapid agricultural productivity growth in China and India has been widely credited with initiating industrialization and inducing rapid reductions in poverty."*
> ***Datt and Ravallion 1998b; Fan 1991; Rosegrant and Hazell 2001; Timmer 2002.***

The World Development Report 2008 produced by the World Bank's illustrated the importance of improved agricultural productivity, brought about by the application of appropriate technologies - often described as the "green revolution ", in reducing poverty. It cited the example of South East Asia where cereal yields increased by 50% and poverty declined by 30% between 1984 and 2002. Whereas Sub Saharan Africa failed to achieve any increase in cereal yields and continued with almost 50% of the population in poverty. (Figure 28)

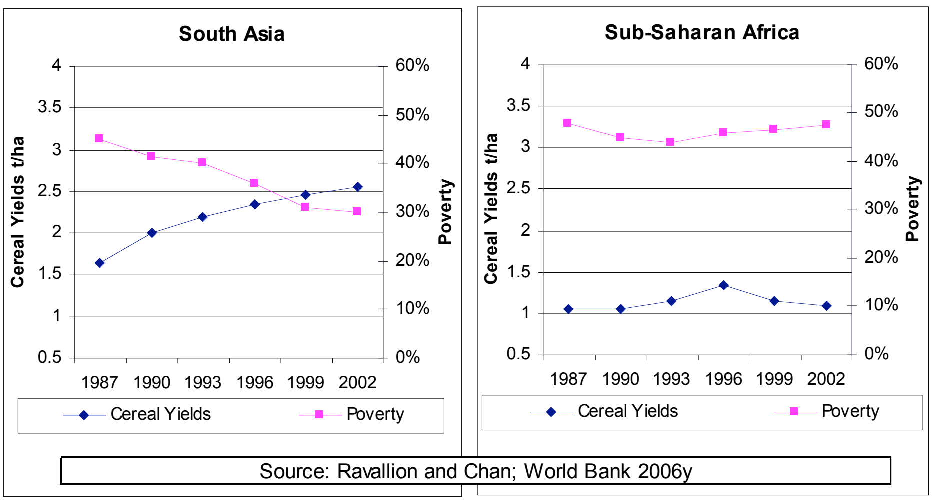


Figure 28: Cereal yield up and poverty down[80]

The ability of the agricultural sector to respond to the demand for staple food commodities by increased productivity is well proven – see Annex 7: World grain productivity. But increased productivity requires economic incentive.

The grower needs to have confidence that by planting crops he will ultimately earn an income to justify the investment in land, machinery, seed, labour and other inputs. This confidence can come from the open market in a well capitalised agricultural sector that has access to market information and able to vary crop production in response to market price signals.

This response to price signals may take the form of changing crop planting decisions from one crop type to another, leaving land idle or modulating the level of agricultural inputs to provide the optimum return according to the crop price. Alternatively confidence can be provided for growers by government agricultural support policies, such as those operated by the EU and US during the 1970's and 80's.

The challenge is to create confidence in a developing country when the developed world has historically produced large cereal surpluses that have often been sold on the world market at less than the local cost of production.

5.2 Low cereal prices have been caused by over supply in a demand constrained market

For the foreseeable future there will always be the continued rising demand for food, including cereals, coming from increased population and rising living standards within the developing world. World population projections from the United Nations indicate a cumulative population increase of 75 to 80 million per annum up to 2050 when the world population is forecast to exceed 9 billion. See Annex 10: Food markets demand constrained

But for more than twenty years the world's food markets have been oversupplied with food. The largest crop surpluses occurring in the industrialised nations such as the USA and Europe and so there have been few opportunities to expand markets for agricultural produce from poorer nations.

> *"Related to export subsidies, the practice of dumping by private agents is said to exist if the export price into another market is less than the cost of production in the country of origin plus reasonable additions for selling cost and profit. Action aid suggests that there are two main impacts: first, low cost imports will put domestic firms out of business; and second, exporters will have to sell into the world market at a lower price to avoid loss of market share. The gap between the export price and the cost of production has been used by Oxfam as an index of export dumping. They find that in the United States and EU, the wheat export price is 46 percent less and 34 percent less than the cost of production respectively.*
>
> **Trade reforms and food security: conceptualising the linkages – FAO 2006**

The economics of food production have often been undermined in developing countries by the dumping of subsidised crop surpluses that have been sold at less than the cost of production. Developing countries could not compete in the export markets and in some cases were even undermined in their home markets.

Effectively whatever demand developed was fulfilled by the developed exporting nations. There was no demand left for the local farmers to satisfy. This was a significant barrier that prevented developing nations from attracting investment to exploit their agricultural resources.

In Figure 29 it can be seen that of the world's leading wheat importers "other developing countries" (excluding China) receive about 80 million tonnes per annum. At the time when China was reducing its import dependency the other developing nations were progressively importing more wheat.

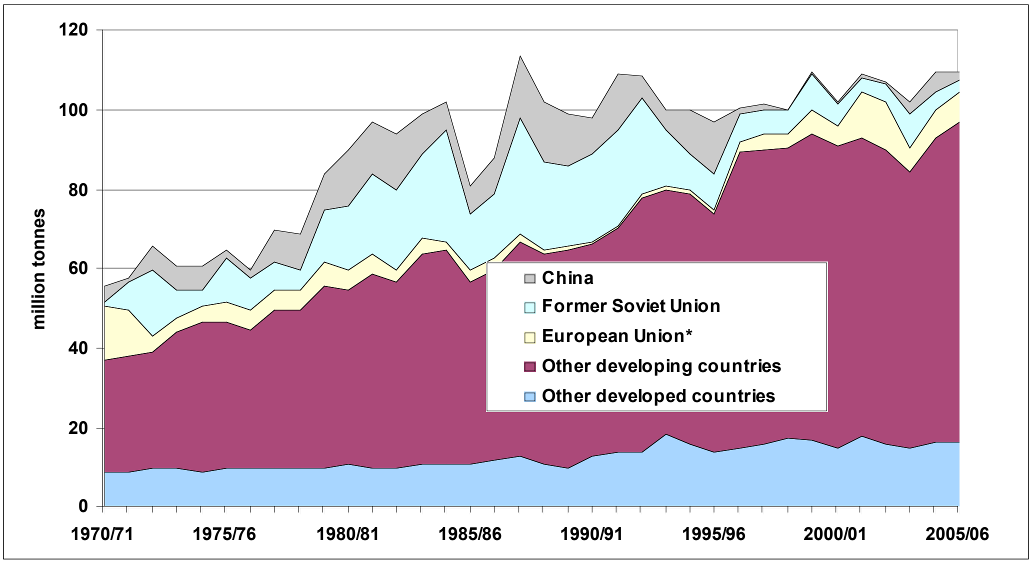


Figure 29: World's major wheat importers[81]

In Figure 30 it can be seen that about 40 million tonnes of the exports were from the subsidised producers in the EU and US. But despite only representing about 1/3 of the world's tradable wheat it is the subsidised grain from the US and Europe that has set the world market price. This is because the buyer will always expect sellers to match the cheapest price in the market place.

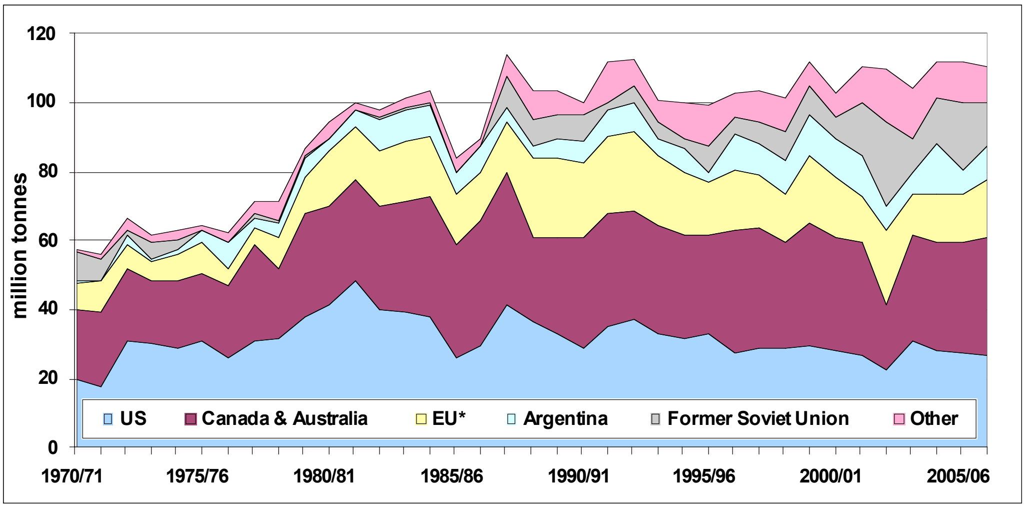


Figure 30: World's major wheat exporters[82]

As illustrated in Figure 31 the net cereal export and import balance between the developed and the developing world was estimated to be 110Mt in 2007[83].

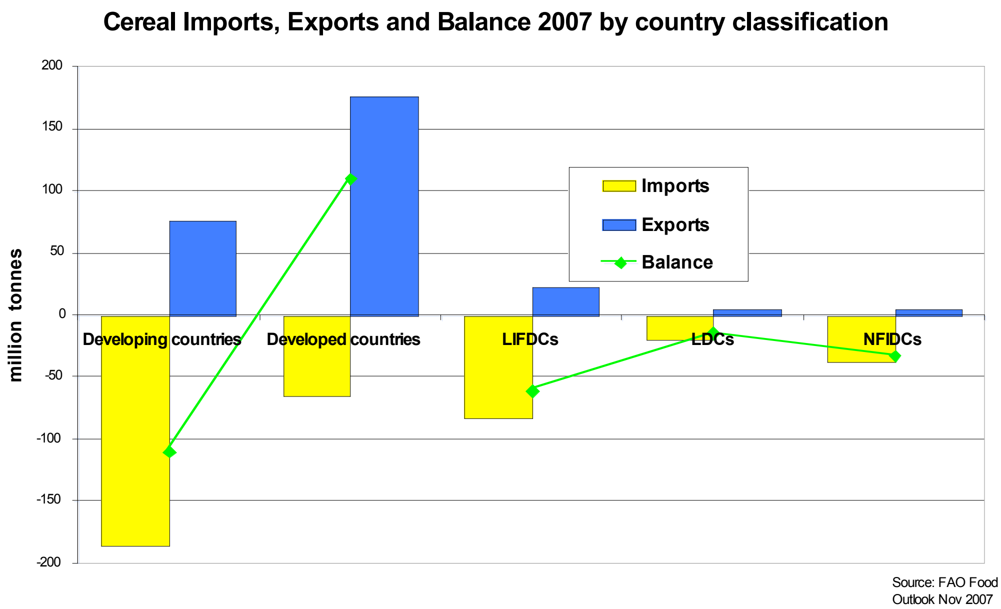


Figure 31: Cereal Exports & Imports 2007

84

"Export subsidies further distort global markets and can destabilize world prices, as developed countries tend to use subsidies more when world prices are low, thus further depressing prices. On the other hand, subsidized exports tend to fall when world prices are high, just at the time when developing countries might be said to benefit from subsidized supplies. Currently, the EU is by far the largest user, accounting for about 90 percent of use"

"A forward looking analysis of export subsidies in agriculture" OECD. 2002.

This unfair competition has stifled the necessary investment in plant breeding, agricultural infrastructure, technical education and the application of appropriate agronomic techniques to improve production.[85]

Using the per capita cereal demand of 344/kg/yr (2030 target in Figure 32**)** the world needs to increase cereal production by an extra 27.5 million tonnes year on year to satisfy the demand projections. Most of this growth for food and feed is occurring in developing countries and so their dependency on the developed world will increase.

"In practice, world agriculture has been operating in a demand-constrained environment. This situation has coexisted with hundreds of millions of the world population not having enough food to eat."

World Agriculture - Towards 2015/2030 - An FAO Perspective

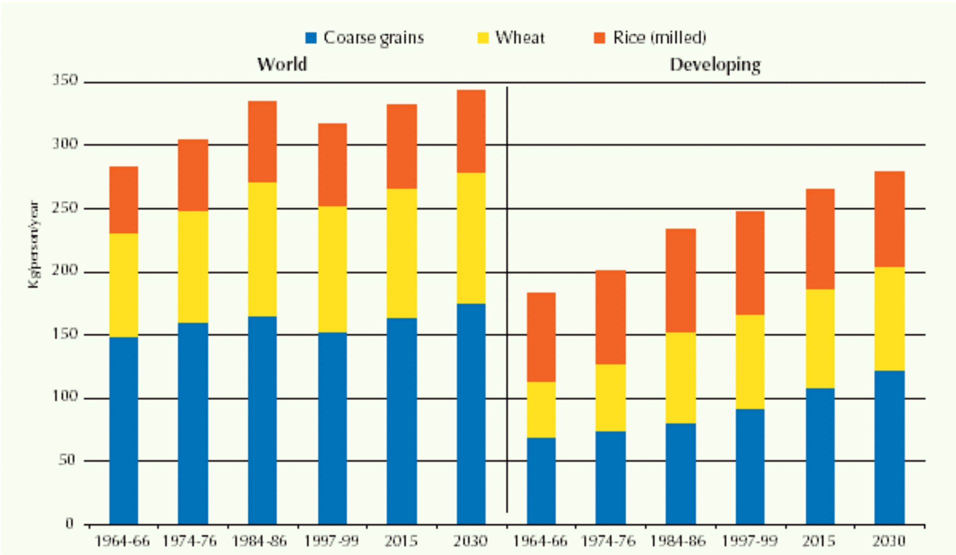


Figure 32: Per capita cereal demand (inc cereals used for livestock)[86]

Compared to the 2007 world cereal harvest of 2.11 billion tonnes it represents a 1.3% annual yield increase. This is a modest yield increase when compared to historical trends, the latent potential in many developing countries, and the potential for technological improvement of crop varieties and agronomy.

"History suggests that periods of reduced supply and high prices are followed by a fairly significant world production response. The high prices of 1974-75, 1980-81, 1988-89, and 1995-96 were followed by relatively large increases in world wheat acreage. Acreage tended to stay large in the second year following high prices and then declined as world supplies became more abundant."

Darrel Good, Economist University of Illinois - March 2007

World cereal production has always tended to keep pace with demand but imperfectly because of delays in the response time from the initial price signal to the new harvest supply.

Demand for the food and feed markets are largely inelastic and so it is the cereal supply fluctuations that depend upon crop planting and weather related crop yields that cause the market imbalances.

5.3 Creates market opportunities for developing countries to produce more food and fuel for their own and export markets

Crop growing conditions are different every year and so there will always be production fluctuations but history shows that in response to high prices the world's major producers, including the subsidised growers of the US and Europe, soon catch up with demand and then oversupply the market. Thus developing nations are then, once again, up against competition from subsidised surpluses from the developed world.

The potential for increased cereal production in agricultural based developing nations is very high as they farm 70% of the world's wheat and maize land (Table 19).

Their relatively small crop yields per hectare compared to the developed world suggest that there is further scope for productivity increases and, because of the large land area involved, would have a very significant impact on world cereal production and income in the rural economy.

	Wheat (Mha)		Maize (Mha)	
World	217.78		158.49	
USA	21.08		34.57	
Canada	8.61		1.37	
EU27	21.02		6.06	
Australia	13.00		0.00	
Developed World	63.71	29.25%	42.00	26.50%
Rest of the World	154.07	70.75%	116.49	73.50%

Table 19 World Crop Areas[87]

Increasing local production and trade in cereals will improve food security and lead to further reductions in poverty. The leading nations in this category are China and India which are already the world's 2nd and 4th largest wheat producers but with low average yields per hectare.

The World Bank Development Report illustrated the impact of the cessation of subsidised exports on various commodities as can be seen in (Figure 33). These price comparisons were of course against 2006 prices when they were often below the cost of production. It can be seen that the developing countries share of world wheat trade would increase by 21% and the coarse grain trade by 5% but that the price increases although important were not excessive at 5% and 7% respectively.

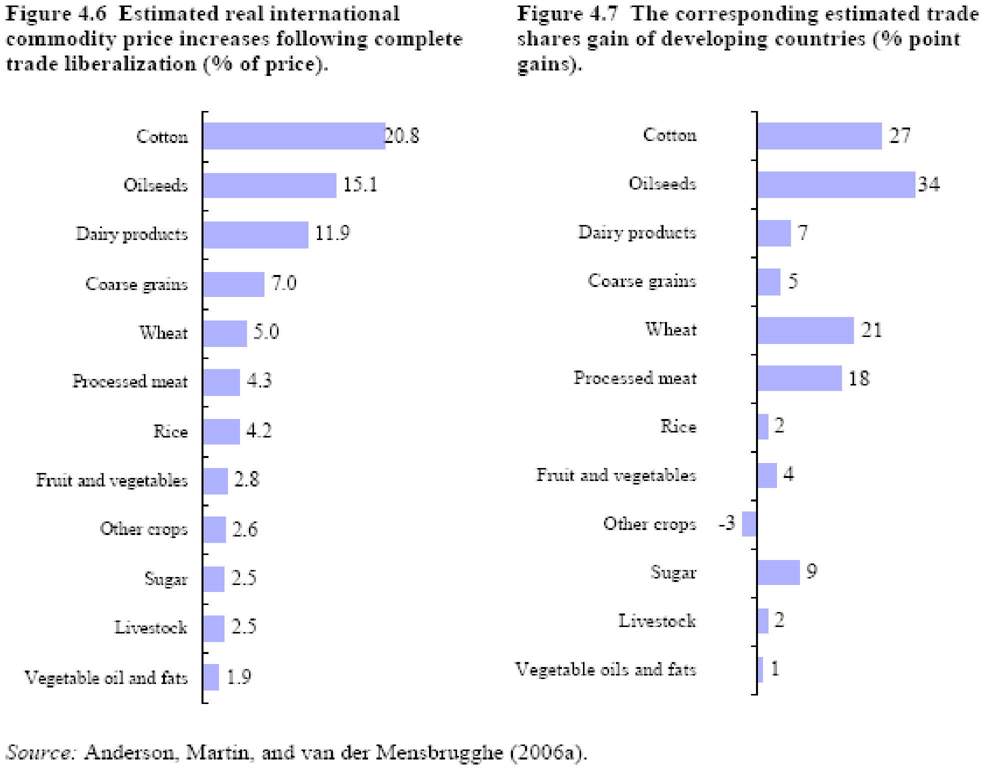


Figure 33: Forecast impact of removal of EU and US export subsidies on the developing world

To exploit the crop production potential farmers in developing nations need confidence that their markets will not be undermined by subsidised exports and that their prices remain above the cost of production. Governments in most developing countries do not have the revenue to provide the market certainty that underpinned the CAP in Europe.

The open market is too volatile for small farmers to risk investing in infrastructure or better seeds and fertiliser.

Bioethanol production in Europe that absorbs an increasing proportion of its cereal surplus and linked to appropriate development policies would improve the market certainty to stimulate more crop production in developing countries. But other measures need to be in place to move local farmers out of the poverty trap that prevents them from maintaining soil nutrients and using the most appropriate seeds for local growing conditions.

In recent years a number of the LIFDCs, notably India and China, have increased agricultural productivity within very large internal markets that are protected by tariffs and other forms of state management. In doing so they are making very positive reductions in poverty as was seen in (Figure 28).

Biofuels can play a part in reducing this vulnerability, particularly in the field of energy. And that is not to mention the fact that, as an energy source, biofuels are not only renewable but also clean and cheap. They also generate income and employment, above all in rural areas, which will help to sustain a flourishing agricultural sector.

President Lula of Brazil – 20th May 2008

But there are other LIFDCs, especially in Sub-Saharan Africa, that have actually seen their grain productivity fall because impoverished farmers have not been able to buy the nutrients that are required to replenish the soils and keep the land productive.

The EU Biofuel Strategy proposed providing assistance to LDCs through a Biofuels Assistance Package[88]. The integration into that package of market access for countries that would enter into a long term development partnerships offers real opportunities to alleviate poverty. Creating markets for appropriate agricultural commodities grown in ways that satisfy both environmental and social objectives for local bioethanol facilities that could be underpinned by supply agreements with the EU.

The choice of development partners is very complicated because there are not just the technical and market issues - there are the important but delicate issues of governance. An essential component of the BAP should be to ensure that the development partner is able to devise and implement a development programme targeted to reduce poverty. It is unlikely that those countries that are involved in industrial scale agricultural operations will be compatible development partners for the BAP.

Development partnerships through BAP linked to supply agreements for feedstock, or where appropriate bioethanol, would provide the market certainty to encourage the investment needed all along the supply chain from small and medium sized family farms through the transport and storage sector to an export terminal or bioethanol plant.

Concentrating support on the small and medium sized producers may actually have a greater productivity impact because the owner producer is likely to be better motivated than poorly rewarded employees on large estates.[89]

"An impressive body of empirical evidence confirms that land productivity is inversely related to farm size in many developing countries. One reason for this is that hired labor is less efficient and more costly to manage than family labor, giving smaller farms a competitive advantage. Another reason may be the higher management intensity that is possible on smaller farms."
Agricultural Research and Poverty Reduction - *Peter Hazell and Lawrence Haddad* - IFPRI - Aug 2001

The BAP would need to assist growers to set-up marketing groups, obtain micro-loans to buy inputs such as seed and fertilisers as well as working with the development agencies on agronomic knowledge transfer.

The BAP would encourage linkages with private and public sector researchers to target R&D on soil improvement, seed development and improved growing techniques for indigenous crops that offer the best local potential such as cereals, cassava, sugar cane or sweet sorghum.

Here the European biofuel traders and producers could work with the developers to provide some market certainty in the form of offtake agreements for feedstocks or biofuels that allow investors to "hedge" their commodity risks[90]

> *"To benefit from modern biological science, complex relations between low-income and high-income countries must be developed and even more complex relations between private sector and public sector research. ... Rate of return analysis shows that all low-income countries are vastly under-investing in applied agricultural research, particularly Africa."*
>
> **World Trade and Food Security – FAO 2006**

As part of the selection criteria for suitable development partners the amount of the available arable land per head will need to be evaluated - because only those nations with the potential to move into an export surplus with the feedstock would be compatible with a pro-bioethanol agricultural policy[91].

To initially screen the list of LIFDCs to see which countries could derive most benefit from the expansion of crop production for food and bioethanol the available arable land per capita is tabulated alongside the existing yield per hectare in (Table 20). Sorting the LIFDCs in descending order of land area reveals that there are 10 countries with one or more hectares of arable land per capita and that only one of them, Belarus, uses more than 100kg/ha of fertiliser compared to France at 204kg/ha. The top ten have current average yields (2003-05) ranging from 0.409t/ha in Niger to 3.627t/ha in Bosnia Herzegovina. Clearly these countries have great yield potential because the lack of capital has caused the productive capacity of the land to be impaired.

LIFDC	Land area		Fertiliser usage kg/ha of arable land	Cereal Production		Cereal Yield	
	Kha 2003-05	ha/capita of ag. Population 2003-05		kg/capita 2003–05	Avg % growth pa 1990–2005	kg/ha 2003–05	avg % growth pa 1990– 2005
Bosnia and Herzegovina	1,109	7.6	41	303	2.6	3,627	-0.1
Belarus	5,636	5.1	185	604	-1.2	2,758	0.4
Nicaragua	2,161	2.2	28	175	5	1,781	0.8
Mongolia	1,200	2.1	4	50	-12	690	-2.8
Armenia	555	1.7	21	127	3.2	1,936	1.4
Turkmenistan	2,266	1.5	..	594	12.1	2,878	3.9
Georgia	1,066	1.3	24	154	3.2	2,050	-0.3
Niger	14,500	1.2	0	246	3.3	409	2.1
Kyrgyz Republic	1,391	1.1	14	325	2.4	2,776	2.3
Azerbaijan	2,064	1	12	246	6.5	2,595	4.4

Table 20: LIFDC countries - land availability[92]

But it is the LIFDCs of Sub-Saharan Africa that suffer most from low productivity for their staple food crops making them more reliant upon food imports. This is where the greatest impact can be achieved from agricultural development linked to bioethanol; either as feedstocks for Europe or for locally produced bioethanol.

> *"The opportunities for income-enhancing diversification are much more constrained in countries with low and stagnant per capita incomes. In these cases, attention needs to be given to developing cash crops for export or expanding opportunities for seasonal migration to cities. Other income-augmenting measures include creation of rural processing facilities to enable higher-value added from agricultural output."*
>
> **Agricultural Research and Poverty Reduction - Peter Hazell and Lawrence Haddad - IFPRI - Aug 2001**

The local non-cereal food crops such as cassava, sugar cane and sweet sorghum have great potential for genetic improvement and enhanced agronomy in SSA to overcome endemic crop diseases, improve soil condition and to enhance drought tolerance. The creation of cash markets for crops that are not generally tradable, other than in very local markets, would transform the incomes of subsistence farmers who, with improved seed varieties and agronomy would be able to produce marketable surpluses[93].

Local grain prices for internationally traded products in a free market are directly related to the cost of alternative supplies

- In countries that have a grain deficit internal prices are based upon "import parity" where the local price is equivalent to the cost of imported grain plus the cost of transporting it from the import point to the local point of consumption. The import price should be equivalent to the lowest sum of export price from a surplus nation and the freight related costs. Internal grain prices are higher than the in surplus countries by at least the cost of freight and handling. The most expensive internal prices will be found at the farthest point of consumption from the import point.
- When countries have a grain surplus internal prices will be based upon "export parity" as sellers have to compete with the comparable grain from other surplus countries - assuming that the freight cost will be the same to the point of import. In this situation the internal grain prices are the highest at the export point and cheapest at the point of production furthest from the point of export.
- It should be noted that these price relationships apply to all of the grain in the market not just the surplus grain.
- Therefore it is in the national interest of the developing country to be a net exporter of cereals as:
    - Internal grain prices will be low
    - Food security will be high
    - Foreign exchange earnings will assist in buying the other essential food

But the logistic disadvantages would have to be overcome – possibly by some local pre-processing of feedstocks and greater investment in transport infrastructure. Despite their logistical disadvantages land-locked nations may still benefit if procurement contracts were devised to include "swap" or "equivalence" arrangements for the feedstocks or bioethanol into local or regional markets.

So large scale EU bioethanol production will reduce subsidised grain exports that coupled with a development package should stimulate targeted feedstock / bioethanol imports and help developing nations to compete in the world food markets to enhance their domestic food security and reduce rural poverty.

5.4 Impact of the alternative 2020 biofuel scenarios

The impacts of the EU biofuel policies all relate to the competition for cereals and oil in the world markets. Under the scenarios A to E the cereal exports range from 6.9 Mt to 85 Mt. The neutral export figure is around 29 Mt. Above that figure the EU exports will put downward pressure on the world market and below it world prices will tend to be lifted.

Scenario key

A	B	C	D	E
DG TREN 10% target from Biofuel Progress Report	Zero Biofuels target	Max EU biodiesel production from EU feedstocks	10% target from EU feedstocks, productivity restrained by environmental restrictions	10% target supplied by imports only

Cereal competition - Low income food deficit countries (LIFDC) that had no opportunities to expand cereal production would suffer food price increases and increased poverty if the EU reduced its exports below the traditional export level. However, if with assistance from the developed world, agriculture could be made more productive within the LIFDC then it would be preferable for the EU to consume more of its own cereals for bioethanol so that world prices could be lifted.

This would then make farming more viable in the developing world and help to reduce poverty and increase local food security. It is the ability of the EU to find alternative valuable uses for its excess cereals under the scenarios A, C and D that creates the opportunity for a renaissance in agriculture that is so important in the developing world.

Under scenarios B and E where no EU cereals would be used for bioethanol the LDCs that rely upon agriculture and those with agricultural potential would have to cope with the downward pressure on world cereal prices caused by 85 Mt of EU exports. This level of exports would depress world markets and undermine the viability of cereal production in many part of the world.

However, scenario E would create world demand for biofuels and their feedstocks from other parts of the world but they would tend to be sourced from non-European feedstocks such a sugar cane, palm oil and soy oil.

Oil competition – Scenarios A, C and D will provide Europe with between 31 Mtoe and 45 Mtoe of biofuels that will displace the demand for the equivalent amount of fossil fuels. This development would reduce world oil prices, based upon EC estimates, by 3%. This will provide a modest reduction in the import costs for all importing nations in the developed or developing world.

Scenario B which is a zero biofuel scenario offers no reduction in world oil prices. E, which relies upon imported biofuels, would displace fossil fuels from Europe but because it was competing to attract biofuels from other markets would not increase the net fuel pool. So it would also offer no easing of oil prices.

5.5 Conclusions

The 2007/08 grain price spike is not expected to provide the long term market improvement necessary to reinvigorate the agricultural sector in the developing world.

The EU's structural grain surpluses will still be generated unless new non-food demand is stimulated within Europe to absorb the excess supply, production is curtailed, or exports of EU subsidised grain are resumed - with the detrimental impact on the agricultural economies of the developing world.

There is a risk new large-scale non-food consumption of cereals could have an adverse effect on food prices - causing more suffering to poor people who are not involved in agriculture. There is also the risk that large scale and rapid agricultural development can actually increase poverty by driving subsistence farmers from their land or even forcing indigenous people into bonded or near slave labour.

Whilst the impact of EU biofuel policy should be positive for developing countries some of the negative experiences of the world's leading bioethanol producer, Brazil, need to be heeded.

Some large scale plantations that have been established by multi-national organisations or very large national developers have led to the eviction of subsistence farmers – depriving them of their crop land and their source of food.

Amnesty International reported on the eviction of 1,800 families by Brazil's military police in 2006[94]

"more than 1,800 families were evicted in July and August, by the Batalhão de Choque da Policía Militar, (Military Police Shock Troops) an elite state police force, from settlements in the southern regions of Pará state, and 1,400 other families are facing imminent forced eviction following a court order obtained by the state authorities."

Amnesty International - AI Index: AMR 19/032/2006 19 September 2006

In some areas of Brazil thousands of villagers have effectively been used as slaves on some large scale sugar cane plantations linked to ethanol production[95]. An open door for ethanol from sources that are unable to prevent this type of treatment will not help fulfil the objective of alleviating poverty nor will it help the public acceptance of biofuels from such areas.

Unregulated, and un-policed, development of highly mechanised monoculture plantations does not provide significant employment opportunities and, when small scale farmers are evicted, the development actually reduces employment.

In the early stages of biofuel and feedstock development it is essential to stimulate enforceable pro-poor agricultural policies that tend to require high levels of labour (i.e. low labour productivity) to achieve high land productivity. As the developing countries advance and there is less agricultural labour available then more mechanised agriculture on a larger scale may become more appropriate.

> *"The development of biofuels has both direct and indirect social impacts, including job creation (quality and permanence), social responsibility and social equity, including issues such as wealth distribution to rural communities."*
>
> **Sustainable Biofuels - Royal Society –Jan 08**

To ensure that biofuels actually help to alleviate poverty and enhance food security in the developing world it will be essential for European legislators and consumers to adopt certification procedures that demonstrate adherence to pro-poor agricultural policies throughout the supply chain.

The most positive results will come from development partnerships as envisage under the Biofuel Assistance Package that will link the stakeholders from the EU, host government, commerce and the development NGOs.

"With careful implementation, the rural poor of these* (developing) *countries, who are mainly farmers, could be major beneficiaries of a new biofuel inspired development dynamic."[96]

6 Impact on food prices and supply by using ligno-cellulosic feedstock for bioethanol production

The availability of competitive feedstocks will be the ultimate limiting factor for the amount of bioethanol that can be produced to substitute for fossil fuels. The industry recognises that the research, development and deployment of more advanced technologies throughout the whole bioethanol supply chain will be essential to achieve more transport kilometres per unit of land area.

As one of the main objectives for using biofuels is to reduce greenhouse gas emissions it would be undesirable to extend crop production areas into virgin forests or other land that has high levels of soil organic carbon (SOC) and biodiversity.[97] So it will be crop yield improvements from starch and sugar crops and the exploitation of ligno-cellulosics feedstocks, rather than additional arable land area, which will provide the greatest increases in feedstocks for bioethanol.

6.1 The EU ligno-cellulosic feedstocks

The development of advanced biochemical and thermo-chemical processes for breaking down the cellulose and hemi-cellulose fractions of crop residues, woody biomass and the biodegradable fractions of municipal waste to produce bioethanol is seen by policy makers and the industry as having very positive impacts on, bioethanol production costs, greenhouse gas reductions and improved rural incomes. And this can be achieved without any additional arable crop area and no additional crop inputs such as fertiliser.

Straw – is, at present, the most promising ligno-cellulosic feedstock available within Europe. Between 3 and 5.5 tonnes of straw[98] are produced on the same fields that provides cereal grains. Simplistically this suggests that, based upon the forecast cereal production area of 62.5 Mha for 2020, Europe will produce a minimum of 188 Mt of straw.

But, despite straw being designated by the EEA as being a waste material, there are large established markets for straw as livestock bedding, fodder, mushroom compost and some industrial uses. There is also a requirement, depending upon local soil conditions, to incorporate a proportion of the straw back into the soil so that organic matter is retained to assist with water retention and to counter mineral deficiencies.

JRC estimate that the amount of straw available across the EU for bioenergy usage, after taking account of competitive uses and up to 50% incorporation, was 820 PJ[99] which, when converted for the energy content of straw of 17.2 MJ/t[100] equates to 48 MT on a dry matter basis. (Figure 34)

In terms of bioethanol potential this amount of straw would yield about 12 Mt or >15 billion litres of bioethanol a year. This would reduce the land area required for ethanol from cereals by >6 Mha compared to using just cereals.

In reality the logistic challenges of handling this low density feedstock will reduce the volume actually consumed but the JRC estimate of 48 Mt is in the same order as the Commission's estimate of 15.5 Mtoe (37 Mt) of straw for producing bioethanol in 2020. There will, however, be further competition for the straw from the biomass combustion sector and the BTL projects.

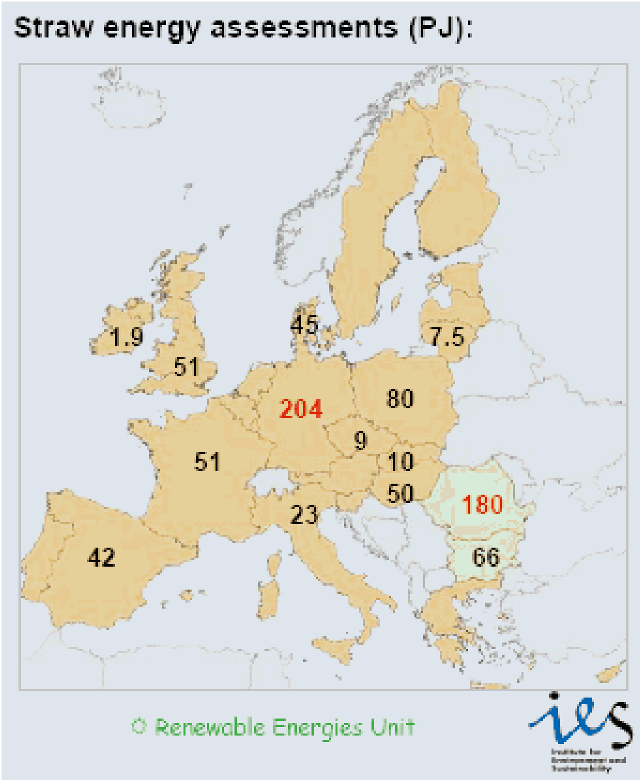


Figure 34: Europe's straw availability

The utilisation of straw as a bioethanol feedstock will allow achievement of the 2020 14% biofuel target and in doing so release more arable land for food production – if required.

At the beginning of 2008 there is no commercial scale straw to bioethanol plant in operation anywhere in the world. The processes are being scaled up from laboratory and pilot plant operations to demonstration plants. The technologies can be refined at each stage to overcome some of the commercial and technical challenges before seeking investor support to build full scale ligno-cellulosic bioethanol plants.

Within Europe the first straw to ethanol demonstration plant, located near Salamanca in Spain, is due to commence production in 2008. The plant owned by Abengoa Bioenergy will use steam treatment to break open the straw molecules and enzyme treatment to release the sugars for yeast and microbial fermentation to produce 5 million litres per annum of bioethanol. Other pilot projects are underway such as the SEKAB plant in Sweden to produce bioethanol from woodchips.

The world's leading enzyme companies Genencor and Novozymes are European companies that are at the forefront of developing and commercialising enzymes to break down the cellulose molecules into the sugar fractions.

Thermo-chemical processes are available to break down biomass - including straw, wood and wastes – into their atomic components and then reform them into ethanol molecules. Again this is a technology that will take many years to become financially viable but it also offers the promise of reducing the land area required to produce the same amount of bioethanol.

Creating new market for straw provides cereal farmers with additional income per hectare that again increases the attraction of grain production. Two income streams from the same field lowers the farmers' break even price for grain so that they can withstand lower grain prices.

6.2 Increasing land availability- using degraded land

When the processes become commercially available the demand for other materials such as woody biomass and grass crops will provide an economic incentive to remediate Europe's small amount of degraded land. The expertise gained may then be available to assist in the restoration of degraded land in the developing world where it is estimated that 75% of the world's 2 billion hectares of degraded land is located.

According to FAO the world has about 2 billion hectares of land that has been degraded by deforestation, overgrazing, fuel wood consumption, agricultural mismanagement, industry and urbanisation (Table 21) To illustrate the enormity of that figure it should be compared with the 2003 to 2005 estimated total world arable and permanent cropland area of less than 1.5 billion hectares[101].

Extent and causes of land degradation	
Degraded area	***Cause***
580 Mha	**Deforestation** - vast reserves of forests have been degraded by large-scale logging and clearance for farm and urban use. More than 220 million ha of tropical forests were destroyed during 1975-90, mainly for food production.
680 Mha	**Overgrazing** - about 20 per cent of the world's pasture and rangelands have been damaged. Recent losses have been most severe in Africa and Asia.
137 Mha	**Fuel-wood consumption** - about 1,730 million m^3 of fuel-wood are harvested annually from forests and plantations. Wood-fuel is the primary source of energy in many developing regions.
550 Mha	**Agricultural mismanagement** - water erosion causes soil losses estimated at 25 000 million tonnes annually. Soil Salinisation and water-logging affect about 40 million ha of land globally.
19.5 Mha	**Industry and urbanization** - urban growth, road construction, mining and industry are major factors in land degradation in different regions. Valuable agricultural land is often lost.
Total 1,967 Mha	*Source: FAO 1996*

Table 21: Degraded land[102]

Most of the degradation has taken place in the developing world where poverty has led to inappropriate short-term farming practices that are actually reducing the amount of land available for future food production. (Table 22)

Land Degradation	Developing countries	Developed countries	World
Degradation process	**Mha**	**Mha**	**Mha**
Water erosion	837	257	1,094
Wind erosion	457	91	548
Loss of nutrients	132	4	136
Salinisation	72	5	77
Pollution	21	0	21
Acidification	5	1	6
Compacting	32	36	68
Waterlogging	10	1	11
Totals	**1,566**	**395**	**1,961**

Table 22: Land degradation by process[103]

Land degradation is often caused by poverty and is itself a reason why poverty persists. The establishment of technologies that can use grasses and woody biomass grown on degraded land will provide an economic incentive for growers to bring the land back into productive condition so that at some stage it can be made available for food production – if required.

The valorisation of crops such as prairie grasses and fast growing woody shrubs provides the economic incentive to remediate some of the world's 2 billion hectares of degraded land and to counter the impact of soil erosion.

The scale of degraded land within Europe is not clear but there are areas that have been seriously damaged by mans' activities. An extreme example is the land contaminated by the Chernobyl nuclear accident in 1986. In December 2007 it was announced that a Belarus bioethanol project was being established to use feedstocks grown from the contaminated land.[104]

The development company, Greenfields, claims that the associated land remediation programme would bring the land back into safe food production within 30 years rather than the 300 to 600 years that experts predict would be occur by natural remediation.[105]

Degraded land is unlikely to be a significant source of bioethanol feedstocks within Europe but as illustrated in (Table 22) 75% is located in the developing world where there are opportunities to gain access to new crops from low value land and in doing so improve food security by reinstating its productive capacity.

6.3 When can it be done?

Many predictions about the timing of commercialisation of ligno-cellulosic bioethanol production continue to be made. Usually it is suggested that it will take between five and ten years to be viable but that has been said since at least the year 2000.

Part of the problem is related to technological issues but mostly the problem is related to plant costs and the risks of scaling up the technology from pilot to demonstration and then commercial scale operation.

There is also the need for market certainty for bioethanol and in the formative years the need for special incentives to offset the higher cost and higher risk processes involved.

The most likely development is for demonstration scale ligno-cellulosic plants to be co-located alongside conventional grain bioethanol plants so that the infrastructure can be shared to dilute some of the extra processing costs.

The total time period from initial conceptualisation of a demonstration plant to operation would be two years. Possibly two years of trials and then, if it is scaleable, a further two years to find a site, obtain building consent, negotiate contracts, and secure funding for a full scale ligno-cellulosic bioethanol plant. Once this has been achieved it would take about two years to build such a plant.

Therefore if this is a fair estimation it would take a total of 8 years to get a full scale plant into operation. On this time scale the start date would be in 2016. As the most likely industrial investors will want to see the operating results from their initial plant before investing in other sites the production of ligno-cellulosic bioethanol will not be a large proportion of the market by 2020.

The alternative will be to import ligno-cellulosic plant designs from the US when they may have proven the processes on an industrial scale. No commercial US plants are currently in operation but some are reported to be under construction. Assuming that the plants are operational within one year and after a year the technology can be judged to be proven then the two year site selection, building consent, contract negotiation and funding period can commence in Europe followed by the 2 year building phase.

In this case the lead time would be six years suggesting a start date in 2014. Even this time scale suggests that ligno-cellulosics will not be significant by 2020.

Europe will need to depend upon starch and sugar bioethanol technologies and the industry can develop ligno-cellulosics in parallel. Then when the technological breakthroughs for ligno-cellulosics occur the processors can, where possible, adapt their existing plants to take the new feedstocks and processes. This provides a smoother transition to the new technology that avoids large commercial risks and the abandonment of existing investments. It also avoids significant disruptions to markets and employment.

6.4 Scenarios - impact on ligno-cellulosic bioethanol production and technology

The benefits of using ligno-cellulosic feedstocks for bioethanol production are universally recognised. The challenge for large scale application in time for the 2020 10% biofuel target depends upon the processes becoming commercially viable on a large scale within the time-frame.

Scenario A - the DG TREN 10% scenario – assumes that 5 Mtoe of ethanol will be produced from straw by 2020. This would represent 7.8 Mt (9.9 Billion litres) of bioethanol. Assuming that these would be world scale plants of 250 kt annual capacities Europe would require more than 30 ligno-cellulosic plants to be operational by 2020. At the current rate of development this seems highly unlikely and the scale of risk is unlikely to be acceptable.

However, a lower risk strategy is the parallel development of ligno-cellulosic bioethanol alongside existing plants may lead to a steady increase in LC production so that by 2020 many smaller plants are in place and larger existing cereal plants starting to convert to the new technology.

The established market for bioethanol under this scenario will ensure a smooth transition from cereal and sugar to LCs with a long period of parallel operation.

Scenarios D & C – based upon EU feedstocks **-** do not depend upon LCs being available but the strong market sector will incentivise research and investment to bring the technology forward to commercial viability as soon as possible. Again the most likely development path with be in parallel with existing cetal and sugar plants.

Scenario B – No biofuels – will see no LC production development within the EU because no domestic market exists for bioethanol. However, academic and some commercial interests may develop the technology but they would tend to gravitate towards the US, Brazil and other markets where bioethanol is an established fuel.

Scenario E – All imported biofuels – would provide a market for bioethanol that could potentially be supplied from EU sources. But unlike A, C and D where the new technology could evolve alongside existing cereal or sugar bioethanol plants the new LC industry would have a high risk market entry that may not be attractive to investors.

7 Summary and Conclusions

1. ***The grain price spike of 2007/08 was caused by cereal production falling behind demand for more than a decade***
    a. *40 Mha less crops grown because of political decisions since 1990s*
    b. *Low prices caused crop yield growth to stagnate since 1990s*
    c. *Poor harvest in Europe, Ukraine & Australia in 2006 and 2007*
    d. *Speculation, government export restrictions and currency factors exaggerated the prices*
2. ***Bioethanol production within Europe did not contribute towards the price spike***
    a. *EU cereal use for bioethanol was less than 1% of annual production and falling throughout the period that prices were rising*
    b. *In 2006/07 28% of the cereals used for bioethanol were grown on set aside land that was not permitted to grow food crops and so could not have an impact on food grain prices*
    c. *One third of cereals used were concentrated into high protein feed and fed to livestock – substituting for some cereals and imported feed ingredients such as soya and having a dampening impact on feed ingredient prices*
3. ***The impact of grain prices on consumer food prices in Europe is very small - cereals make up less than 5% of ingredient cost in bread and not more than 20% on average in all cereal based food products.***
    a. *Price changes for the other 80% to 95% of food costs have a greater impact than the basic cereal price*
    b. *Oil prices that have risen by more than 600% since 1998 are having an impact all along the food supply chain through agriculture, distribution and packaging – A US estimate suggests that rising energy prices have ten times the impact on retail food prices than the cost of cereals*
4. ***The impact of the EU 2020 biofuel target on EU grain prices and food security, when using accredited EU feedstocks and proven technology, will be to reduce price volatility, stimulate productivity and re-establish long term downward trend in real prices***
    a. *Create a new home market for cereals that will give the confidence for growers to invest in improved cereal productivity- especially in the new agricultural Member States. It was the long-term productivity trend that allowed real grain prices to fall for decades without disincentivising production from the 1960s until the 1990s when the lack of demand became the constraint.*
    b. *By 2020 the EU27 will be capable, based upon historic yield trends, of producing enough cereals for up to 27 Mtoe of bioethanol (8.7% of all EU fuel) through productivity increases and the use of 50% of the set-aside land area. Under the same scenario EU agriculture would also provide oilseeds for biodiesel production that would add a further 5.4 % of fuel. Therefore a maximum 2020 biofuel yield from proven technologies using EU feedstocks would be 44.7 Mtoe or 14% of EU transport fuels. A more restrained productivity growth trend and less land allocation to oilseeds would provide 26 Mtoe of bioethanol and 4.5 Mtoe of biodiesel representing a total of 10% transport fuel by 2020.*
    c. *Cereal demand for bioethanol is elastic so that, when prices reach uneconomic levels the industry reduces its consumption. But when grain prices get very low it will take the opportunity to absorb more cereal to produce more renewable fuel.*
    d. *When the EU bioethanol industry reaches a critical mass it will effectively provide a floor and a ceiling for grain prices.*

  e. *The large pool of grain that was planted for food, feed and bioethanol can be re-allocated to the inelastic food market immediately within a marketing year in response to price signals. Without the cereal pool for bioethanol, consumers would have to wait for up to 21 months before farmers could respond by growing new supplies.*
  f. *Under all scenarios considered in this study the EU27 will continue to be an exporter of cereals so that internal prices will be restrained by the world market levels and the EU's impact on the world grain market will be generally neutral.*
  g. *The production of biofuels within Europe creates new fuel supply that will tend to dampen world oil prices. The EC estimates a reduction of 3% when biofuel replaces 14% of EU transport fuels – a US estimate suggests that the world biofuel industry in 2008 had restrained world oil prices by 15%. Lower oil prices will tend to lower distribution, processing and packaging costs throughout the food supply chain.*

5. ***Producing biofuel for the EU 2020 target from EU accredited feedstocks will tend to reduce poverty in the developing world by allowing their domestic agriculture to expand without the threat of subsidised cereal exports from Europe.***
  a. *It is poverty that is the main cause of hunger in the developing world*
  b. *Agriculture is the best economic driver for poverty reduction as more than 70% of people in poverty depend upon the rural economy*
  c. *Europe's direct impact will depend upon the scale of cereal exports – less exports will increase world prices whereas more exports will reduce them*
  d. *The EU 2020 biofuel target can be achieved without reducing its exports. In some productivity scenarios it could actually increase exports. With no biofuels it would certainly increase exports*
  e. *A substantial European bioethanol industry, because of its elasticity of demand, would tend to adjust its cereal consumption according to price. If world prices rose then the industry would consume less and the excess would be exported and tend to dampen world prices. If prices fell then the industry would absorb more cereals, reduce exports and tend to support world prices.*
  f. *There are opportunities for importing feedstocks and biofuels into Europe from developing countries but as many of the potential suppliers are dependent upon fuel oil imports it should be more economic to utilise the biofuel in their home market.*
  g. *It will be more difficult to ensure that imported feedstocks and biofuels can be produced without direct and indirect land use changes in developing countries with the associated greenhouse gas and biodiversity impacts. There is also the risk of undesirable social impacts caused by policies that do not provide protection for rural workers and subsistence farmers.*
  h. *Biofuel development partnerships with Sugar Protocol countries affected by the reform of the EU sugar regime are likely to provide the development opportunities with monitoring and implementation mechanisms that prevent undesirable environmental and social consequences. To have the maximum impact on reducing poverty the policies must be pro-poor biased by creating greater employment opportunities and market access for small farmers.*

6. ***The introduction of biofuel technologies that utilise ligno-cellulosic feedstocks by 2020 will reduce dependence upon cereal and sugar based feedstocks – reducing competition for food crops and expanding the land available for sustainable feedstock production***
  a. *Utilisation of agricultural residues, such as straw, provides additional income per hectare for growers and reduces the break-even level for crop production*
  b. *Utilisation of the biodegradable fraction of municipal waste, biomass feedstocks such as switchgrass from non-arable land, and agricultural residues all reduce competition for food crops from arable land.*

c. *The valorisation of ligno-cellulosic feedstocks provides an economic incentive to use degraded land in Europe and the rest of the world. This will present an opportunity to remediate the land so that it may be brought back into food crop production if required.*

d. *The EC projections for "2nd generation" biofuels by 2020 may be optimistic but, as demonstrated in this study, EU agriculture can provide sufficient starch and sugar feedstocks until large scale production of ligno-cellulosic bioethanol becomes economically viable*

e. *Without the large scale EU market for bioethanol from proven technologies it is unlikely that "2nd generation" technologies in Europe will attract sufficient investment in research and infrastructure to become a commercial reality.*

7. ***To achieve the biofuel target for 2020 and obtain the benefits for EU food prices and world agriculture, EU public policy must ensure that the biofuel market is not capped by the inability of vehicles to use the fuel and the lack of access through the fuel distribution system***

    a. *Flex fuel cars give consumers the choice to reduce fossil fuel consumption by up to 85% when E85 fuel is available and competitive. As the capital cost of these vehicles is very similar to that of conventional petrol types they should be established as the standard models for Europe. In early 2008 90% of all new car sales in Brazil were FFVs, in the USA most major OEMs sell FFVs and in Europe there were 20 models available from 9 manufacturers. But without an extensive E85 distribution infrastructure in Europe the FFVs will only be able to use petrol and there is little incentive to purchase these models.*

    b. *Under current progress by 2020 only 9% of the European fleet will be FFVs. This, along with E10 as the standard petrol specification, would effectively cap the EU bioethanol market at 20.8 Mtoe. In some scenarios Europe will produce excess bioethanol that will need to be exported at the same time that Europe will continue to import more than 85%, circa 260 Mtoe, of its transport fuel from fossil sources.*

    c. *In 2008 all new car models were E10 compatible and, with a few exceptions, cars had been E10 compatible for more than 10 years earlier. E10 needs to become the EU unleaded petrol standard to enable bioethanol to quickly displace fossil fuel.*

    d. *Motor manufacturers need to be looking to "future proof" their new models by either making the FFV their standard design or ensuring that new models are E20 compatible.*

8. ***The proposed EU Renewable Energy Directive and its 10% minimum biofuel target offer a secure policy environment for investment by agriculture, seed developers, the motor industry, biofuel producers, fuel distributors and consumers. It should protect them from the risks of inappropriate political "knee-jerk" reactions, to transitory market developments, that can undermine confidence to invest, innovate and develop the biofuel supply chain.***

    a. *Public policy on biofuels needs to be clear and consistent with long term progressive targets building up to the 10% minimum 2020 target.*

    b. *It needs to recognise that Europe has slack agricultural capacity – especially in the new agricultural Member States - that can respond to the new demand for cereals in a sustainable manner without any potentially damaging land use changes.*

    c. *The creation of a new industry that will supply Europe with strategically important fuel supplies and re-invigorate agricultural production for food, feed and fuels entails the building of an expensive infrastructure. These are high risk investments that industry will be prepared to fund but it needs to know that domestic producers are not expected to meet higher standards than importers and that for the foreseeable future Europe does not become the destination for bioethanol surpluses from established producers that undermine EU biofuel prices and investment.*

8 Annexes

Annex 1: Cereal trade balances 2005/06 to 2007/08

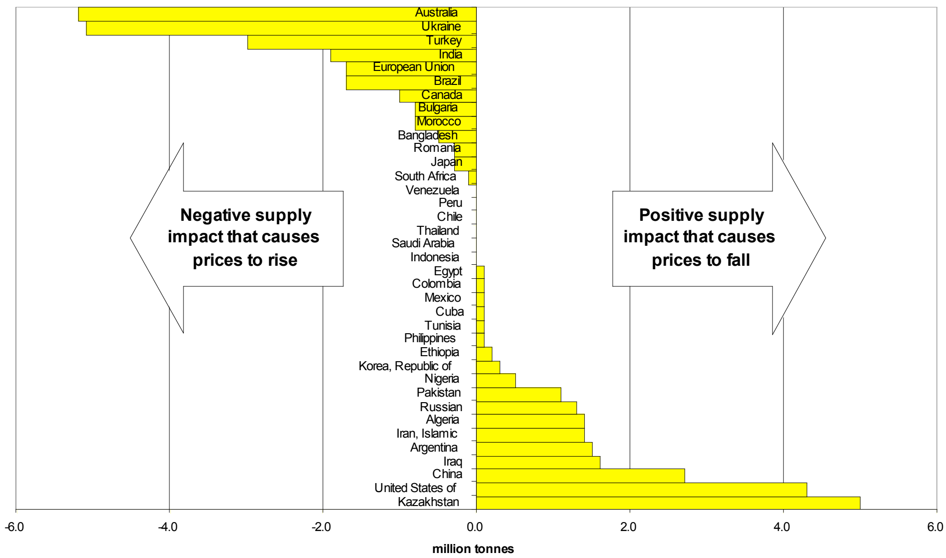


Figure 35: Wheat - Net impact on world market by exporters and importers between 2005/06 and 2007/08 (Mt)

The countries that had the most negative impact on wheat supply between 2005/06 and 2007/08 were Australia, Ukraine, Turkey, India, the EU and Brazil. The Countries that had the most positive impact on supply were Kazakhstan, the USA, China, Iraq, Argentina and Iran.

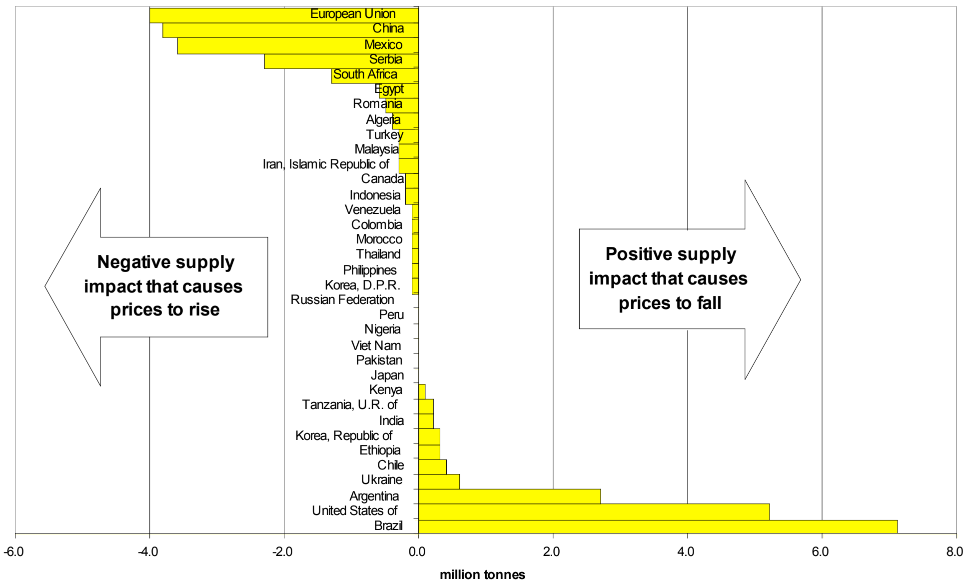


Figure 36: Maize - Net impact on world market by exporters and importers between 2005/06 and 2007/08 (Mt)

The greatest negative impacts were caused by the EU, China, Mexico, Serbia and South Africa. The most positive impacts came from Brazil, USA, Argentina and the Ukraine.

Annex 2: Analysis of 5 EC 2020 scenarios

In this Annex the five commission scenarios are broken down by weight, volume and land area.

The feedstock impacts are considered – especially with regard to the scale of cereal exports that will result from each scenario.

	2020 BIOFUEL TARGET	**7%**	**10%(a)**	**10%(b)**	**14%(a)**	**14%(b)**
	Biofuel Source	**Mtoe**	**Mtoe**	**Mtoe**	**Mtoe**	**Mtoe**
Domestic	ethanol from sugar beet	0.6	0.8	1.0	0.8	0.6
	ethanol from cereals	6.9	12.7	10.8	12.7	6.9
	cellulosic ethanol from straw	2.1	5.0	3.5	5.0	0.0
	domestic total	**9.6**	**18.5**	**15.2**	**18.5**	**7.5**
Imports	ethanol from sugar cane	0.8	0.3	1.3	0.9	11.9
	total ethanol	**10.4**	**18.8**	**16.5**	**19.4**	**19.4**
Domestic	biodiesel from oilseeds	4.7	4.7	8.7	3.9	4.7
	BTL from farmed wood		0.0	5.3	10.5	
	BTL from straw	2.5	2.5		0.5	7.5
	domestic total	**7.2**	**7.2**	**14.0**	**14.9**	**12.2**
Imports	rape for biodiesel	2.4	2.4		2.6	2.6
	palm for biodiesel	0.4	0.0		2.9	4.2
	soy for biodiesel	2.6	2.6		3.2	4.6
	unspecified biodiesel			5.1		
	total biodiesel import	**5.4**	**5.0**	**5.1**	**8.7**	**11.4**
	total biodiesel	**12.6**	**12.2**	**19.1**	**23.6**	**23.6**
	TOTAL BIOFUELS	**23.0**	**31.0**	**35.6**	**43.0**	**43.0**
	share of imports	27%	17%	18%	22%	54%
	share of diesel replacers	55%	39%	54%	55%	55%
	share of second-generation	20%	24%	24%	37%	17%

Table 23: Five EC 2020 biofuel scenarios

It should be noted that only the 10 %(b) scenario relates to EU27 whereas the others are based upon EU25.

Feedstocks

The impact of EU bioethanol feedstock demand on food security and food supplies will depend upon the scale of indigenous production and the influencing factors; competition for land use, economics of cereal production and the response of the growers to price signals.

The Commission's five scenarios provide land estimates but only 10%(b) is based upon EU27 and the others are EU25. The addition of Bulgaria and Romania changes the land area available, the total bioethanol market and the average cereal yield data. To ensure the comparative value of these scenarios the average yield data and areas have been taken from the most recently published EC scenario (10%(b)).

The projected scale of bioethanol demand is better appreciated when the figures are converted from the energy values from Table 23 into weight and volume as shown in the following tables.

2020 BIOETHANOL WEIGHT	7%	10% (a)	10% (b)	14% (a)	14% (b)
	Mt	Mt	Mt	Mt	Mt
ethanol from sugar beet	0.9	1.2	1.5	1.2	0.9
ethanol from cereals	10.8	19.8	16.9	19.8	10.8
cellulosic ethanol from straw	3.3	7.8	5.4	7.8	0.0
domestic total	**15.0**	**28.9**	**23.8**	**28.9**	**11.7**
ethanol from sugar cane	1.2	0.5	2.0	1.4	18.6
total ethanol	**16.2**	**29.4**	**25.8**	**30.3**	**30.3**

Table 24: 2020 bioethanol consumption by weight

2020 Biothanol Volume	Billion litres	Billion litres	Billion litres	Billion litres	Billion litres
ethanol from sugar beet	1.2	1.6	1.9	1.6	1.2
ethanol from cereals	13.7	25.1	21.4	25.1	13.7
cellulosic ethanol from straw	4.2	9.9	6.8	9.9	0.0
domestic total	**19.0**	**36.6**	**30.2**	**36.6**	**14.9**
ethanol from sugar cane	1.6	0.6	2.6	1.8	23.6
total ethanol	**20.6**	**37.2**	**32.7**	**38.4**	**38.4**

Table 25: 2020 bioethanol consumption by volume

Under the first four scenarios the feedstocks for bioethanol will come principally from EU cereal and sugar beet. Whereas in the fifth scenario, 14%(b), the majority of bioethanol, 61% (18.9 billion litres), will be sourced from sugar cane processors based in the tropics.

Indigenous production is highest at 36.6 billion litres for both 10%(a) and 14%(a) where imports represent 2% and 5% respectively. These are the scenarios that could be considered to be most challenging for the availability of domestic feedstocks and therefore stimulate more competition for arable land

Using the average crop yields for bioethanol feedstocks, derived from the 10%(b) scenario, the domestic land areas required are calculated for all five scenarios and shown in Table 26.

Feedstock areas	7%	10% (a)	10% (b)	14% (a)	14% (b)
ethanol from sugar beet	0.45	0.60	0.74	0.60	0.45
ethanol from cereals	6.68	12.30	10.46	12.30	6.68
cellulosic ethanol from straw (included within cereals area)	2.18	5.20	3.59	5.20	0.00
domestic area	**7.13**	**12.90**	**11.19**	**12.90**	**7.13**
ethanol from sugar cane	0.22	0.08	0.36	0.25	3.26
non EU area	**0.22**	**0.08**	**0.36**	**0.25**	**3.26**
proportion of EU27 land area	1.6%	2.9%	2.4%	2.9%	1.6%
proportion of EU27 agricultural area	3.7%	6.8%	5.7%	6.8%	3.7%
proportion of EU27 arable area	5.9%	10.8%	9.2%	10.8%	5.9%
proportion of EU27 cereals area	10.7%	19.7%	16.7%	19.7%	10.7%
EU27 land area	429.5	429.5	429.5	429.5	429.5
EU27 agricultural area	182.1	182.1	182.1	182.1	182.1
EU 27 Arable area	113.8	113.8	113.8	113.8	113.8
EU 27 Cereals area	62.5	62.5	62.5	62.5	62.5

Table 26: Bioethanol feedstock land requirements

Land area

Under the highest domestic scenarios, 10%(a) and 14%(b), the proportion of agricultural land area required is less than 7% and the proportion of arable area is less than 11%. This in fact overstates the area required as the production of DDGS, the co-product of bioethanol production, substitutes for other protein and cereal crops in the animal feed sector. This displacement of feed ingredients is discussed in Annex 5: DDGS and other animal feeds.

It should be noted that EU bioethanol feedstocks will come from existing arable land and mainly be sourced from crops redirected from other markets, such as feed and exports, and increased crop productivity.

Productivity increases are also likely to be the main source of sugar cane ethanol imports in the first four scenarios. However the 14%(b) scenario which assumes 24 billion litres will require significant land use change or extreme competition with other ethanol users. Based upon recent Brazilian yield estimates 3.3 Mha of new sugar cane production will be required to supply this scenario – the equivalent of increasing Brazilian sugar cane land area by 60%.

Straw

Straw is a co-product of cereal production that will, in the largest use scenarios, come from 5.2 Mha of the total 62.5 Mha cereal crop area. In scenarios 10%(a) and 14%(a) it will substitute for 10 billion litres of ethanol that would otherwise have required about 25 Mt of cereal feedstocks from 5 Mha of arable land, or alternatively, required the equivalent amount of additional ethanol imports.

Straw will become increasingly important as ligno-cellulosic process technologies are commercialised during the coming decades. The utilisation of straw for bioethanol will be particularly beneficial[106] for the economics of cereal production because it provides additional income from the cereal land and improves the profitability of cereal production[107].

The Biofuel Progress report indicated that by 2020 15.5 Mtoe of straw would be utilised for the production of biofuel, both ligno-cellulosic ethanol and BTL. This amount of straw represents 38.4 Mt of straw by weight[108] and, assuming a conservative straw yield of 3.5 tonnes per hectare, would require the production from about 11 Mha or just 18% of the forecast cereal production area.

However, in scenario 14%(b) the European bioethanol market will be dominated by imported sugar-cane ethanol making it less attractive for investors to support the higher risk, and currently more expensive, ligno-cellulosic process technologies for straw.

Cereal markets

The EU cereal markets will continue to be dominated by the main cereal consumers from the food and feed sectors. Demand levels are projected to reduce slightly over the period up to 2020 as EU population levels decline slightly and the livestock sector contracts. Nevertheless the non-bioethanol cereal demand is expected to be in excess of 250 Mt per annum or about 80% of EU production.

Projections derived from the Commission's papers

- Cereal production by 2020 is forecast to reach 317.3 Mt[109] - an increase of 50 Mt compared to 2006 on a land area of 62.5 Mha.
  - *NB - a similar output was achieved in 2004 when the EU27 states produced 321.85Mt[110] - but on 2.8 million less hectares.*
- the assumed 1% cumulative yield increase up to 2020 is expected to contribute 38 Mt of the increase based upon a very low starting yield of 4.4 t/ha[111]
  - *the sensitivity of this cumulative yield increase can be compared by using the five year EU27 average cereal yield of 4.71 t/ha[112] and a 1.75% annual yield increase which would result in 76Mt increased cereal production by 2020. (NB the EU25 actual average yield increase between 1974 and 2004 was 2.5% per year)*
- cereal consumption[113] for bioethanol will be 69 Mt for scenarios 10%(a) and 14%(a), 59 Mt for 10%(b) and 38 Mt for the 7% and 14%(b) scenarios.
- After providing for forecast food, feed and bioethanol demand there would be cereal surpluses[114] ranging from 6 Mt to 38 Mt.

Estimated EU27 cereal surplus under the five bioethanol scenarios	7%	10% (a)	10% (b)	14% (a)	14% (b)
	Mt	Mt	Mt	Mt	Mt
Cereal production	317.3	317.3	317.3	317.3	317.3
Food, feed & other industrial demand	252.7	252.7	252.7	252.7	252.7
Cereal usage for bioethanol (5.46t/Mtoe)	37.7	69.3	59.0	69.3	37.7
Cereal imports	10.9	10.9	10.9	10.9	10.9
EU27 Cereal Surplus	37.8	6.2	16.5	6.2	37.8

Table 27: Cereal surplus projections 2020

The actual EU cereal production achieved by 2020 will depend upon the overall demand for the grain, irrespective of use, for food, feed or bioethanol, and the related price signals that will cause growers to moderate or increase supply to meet that demand. The production response to price signals will always be subject to the delay from the time that prices cause growers to change the planting levels and the harvesting of the subsequent crop. High cereal prices such as those experienced in 2007 and early 2008 are likely to provide a surge in production that will once again create embarrassing crop surpluses within Europe.

Commission 2020 Scenarios and EU impacts				
Target	**Ethanol imports**	**Ethanol production**	**Grain & Feed market**	**Comments**
7%	8% (1.6 Bl) sugar cane bioethanol	14 Bl domestic production capacity is less attractive for new investors who would see better potential in large scale US and Brazilian markets	Maintenance of a structural cereal surplus in excess of 33 Mt that will require a regular export program Tend to dampen cereal prices within European and world markets. Continuation of protein import dependency	Insufficient demand to incentivise the development of technologies for alternative feedstocks such as ligno cellulosics ethanol from straw. There will also be less incentive to use expensive new technologies when cereals will be cheap because of the large cereal surplus.
10%(a)	2% (0.6 Bl) sugar cane bioethanol	A strong 25 Bl bioethanol sector consuming a large part of the cereal surplus above the food and feed demand	Low volatility for price and planted area Minimal cereal exports Low dependency on feed protein imports Tend to lift internal and world prices because of the low level of exports Should improve the economics of cereal production in the developing world. Substantial reduction in protein import dependency	A stable internal market that encourages investment in agriculture especially in the new agricultural MSs. Encourages improved agricultural productivity + R&D Sustains investment in ligno cellulosic technology

10%(b)	8% (2.6 Bl) sugar cane bioethanol	A good 22 Bl minimum domestic base from which to grow the EU bioethanol industry toward the optimum 14% target	Low volatility for price and planted area Moderate cereal exports Low dependency on feed protein imports	A stable internal market that encourages investment in agriculture especially in the FSU MSs. Encourages improved productivity + R&D Potential to grow when cereal production, with the help of new investment in infrastructure and agronomy, exceeds the conservative EC forecast
14%(a)	5% (1.8 Bl) sugar cane bioethanol	A strong 25 Bl bioethanol sector consuming the cereal surplus above the food and feed demand	Low volatility for price and planted area Minimal cereal exports Low dependency on feed protein imports Tend to lift internal and world cereal prices because of the low level of exports Should improve the economics of cereal production in the developing world. Substantial reduction in protein import dependency	A stable internal market that encourages investment in agriculture especially in the FSU MSs. Encourages improved agricultural productivity + R&D Sustains investment in ligno cellulosic technology
14%(b)	61% (24 Bl) sugar cane bioethanol	14 Bl domestic production capacity is less attractive for new investors who would see better potential in large scale US and Brazilian markets	Maintenance of a structural cereal surplus in excess of 33 Mt that will require a regular export program and tend to dampen cereal prices within EU Continuation of protein import dependency	Insufficient demand to incentivise the development of technologies for alternative feedstocks such as ligno cellulosics ethanol from straw. There will also be less incentive to use expensive new technologies when cereals will be cheap because of the large cereal surplus.

Table 28: Summary of impacts from the 5 Commission scenarios

Annex 3: The Grain Mountains

The EU common agricultural policy incentivised increased cereal production by providing price support that stimulated an unprecedented rise in productivity. The open market wheat price was supported by providing farmers with the right to sell their grain for Intervention storage at fixed prices. But open market prices were usually held above that level by export programmes that were subsidised by EU payments making-up the shortfall between the world market price and internal EU prices. Figure 37 illustrates the strong yield improvement trend for wheat from 1971 until 1991. The rising productivity correlates well with rising or stable prices. A further increase occurred in 1995/96 but since that time yields have plateaued as prices have fallen.

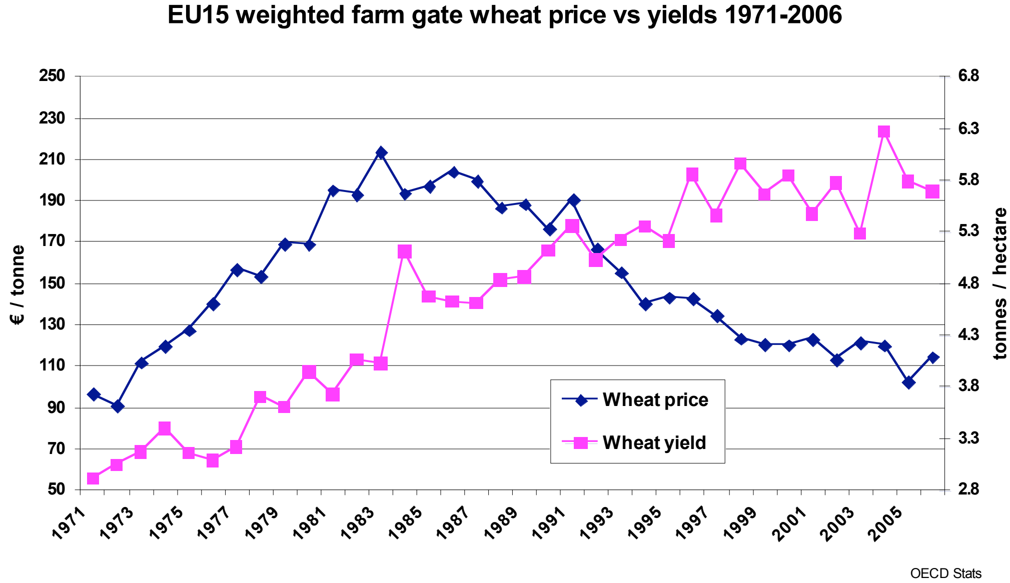


Figure 37: EU15 wheat yields and farm-gate prices 1971 - 2006

The increased yields led to EU wheat surpluses as can be seen in Figure 38, where it can also be noted that the levelling off of yields coincides with the falling surpluses and, in poor harvest seasons, Europe becoming a net wheat importer.

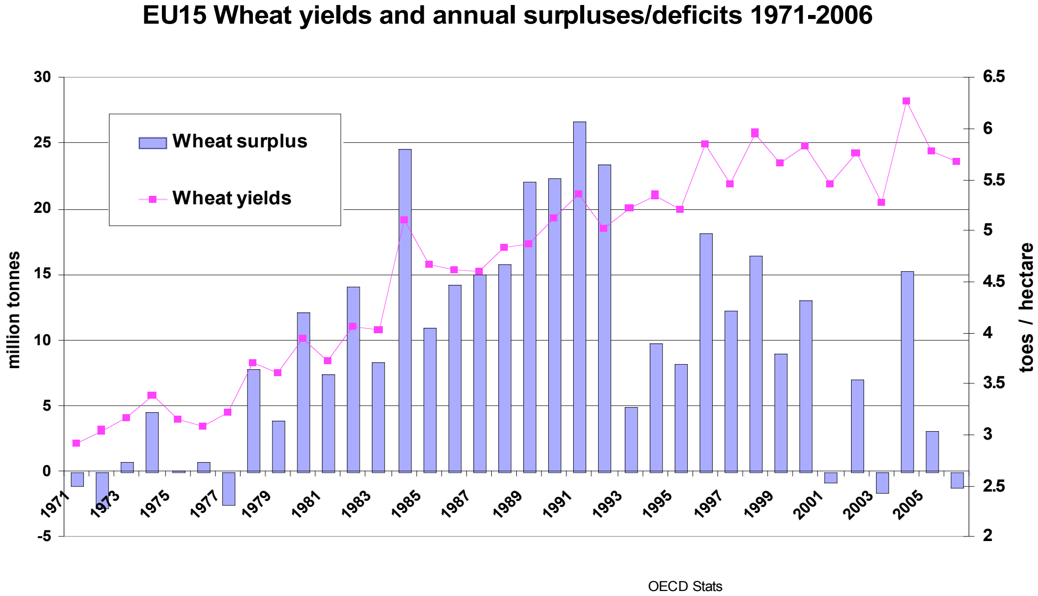


Figure 38: Rising wheat yields and annual supply demand balances

Other cereals such as barley and rye were also in surplus so that by the early 1990s, despite an active export programme, the annual surpluses accumulated to create the "Grain Mountains". The reason that the EU found it difficult to dispose of its surpluses in the world market was that the US was also producing large surpluses that were building up their own Grain Mountains of wheat and maize.

The peak of EU Intervention closing stocks was reached in 1992 at 33.3 Mt but stocks fell dramatically in 1995/96 following the price spike that occurred following a poor US harvest in 1995. (Figure 39)

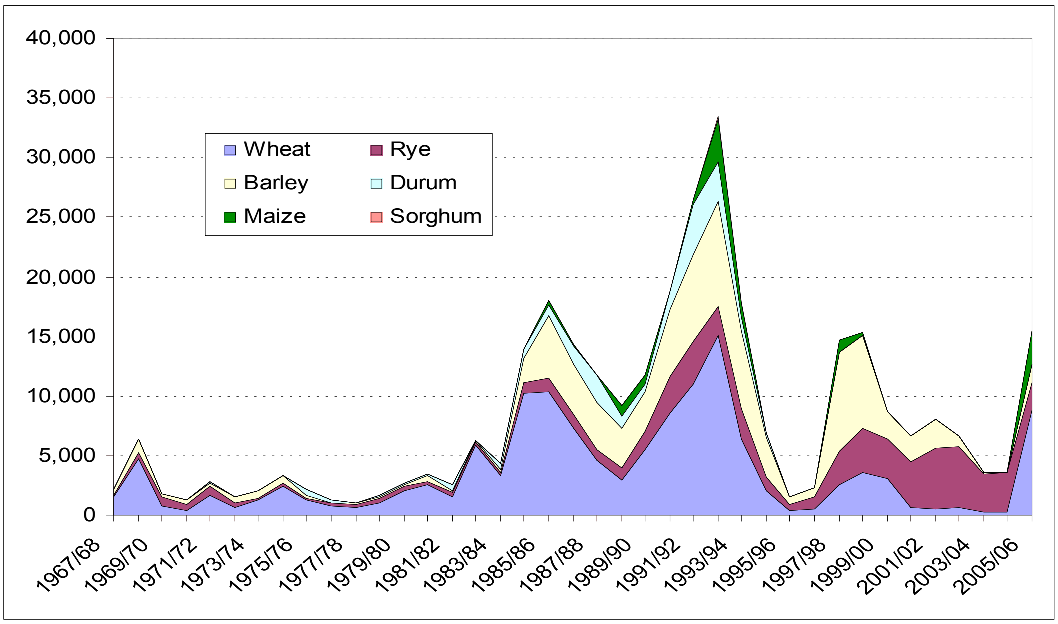


Figure 39: EU End of Season Intervention Stocks of Cereals 1968 - 2006

Cereal Intervention stocks were not officially considered as part of a strategic food reserve but, in practice, they partially fulfilled that role and dampened open market grain prices. Traders were always aware that the Grain Management Committee of the EU could release stocks at anytime to cover short supply situations.

Therefore when the Intervention stores were virtually emptied in the 2006/07 season, at the same time as the rest of the world emptied their stores; it helped to fuel the price panic as it was perceived that the world's "food stores" were nearly empty.

Annex 4: Notes of EU crop yield growth

Crop productivity - In the alternative scenarios the annual productivity increase for sugar beet and oilseed rape to 2020 have been accepted as 2.00% - as projected by DG AGRI. But the productivity of the main feedstock, cereals, has been reviewed by analysing historic trends and considering which productivity growth rate is most applicable in the different scenarios.

Cereal yields for the EU15 during the period 2004 to 2006 averaged 5.76 t/ha whereas for the same period the new Member States produced 3.67 t/ha.[115] These figures are used as the base yields on which to build the scenario productivity growth trends.

EU15 Cereal growth trends

Growth rates have been considered for two periods 1970 to 1992 and 1993 to 2006. The division between 1992 and 1993 was chosen to correspond with the major changes in the Common Agricultural Policy – generally described as the McSharry Reforms. The most significant changes for the arable sector were the introduction of compulsory set-aside and sharp reductions in Intervention support prices as well as a tightening of rules that made the support scheme less attractive for growers.

The trends were calculated by taking the three year average yield for 1969-71 and 1990-92 for the Pre McSharry trend. The Post McSharry trend was calculated from 1993-95 average yield and that of 2004-06. The growth trend is assumed to follow the pattern of a year on year percentage change – exponential growth.

The EU15 Pre McSharry annual yield increase for the 22 year period was 2.37% whereas the Post McSharry trend was 1.23%. The reduction in support prices caused EU prices to fall nearer to the World market price and, in doing so, disincentivised farmers from aiming for high yields. They shifted towards more careful management of agricultural inputs to reduce costs, and the main casualty was the use of nitrogen fertiliser. (Figure 40) But despite the collapse in Nitrogen fertiliser use in the early 1990's cereals yields continued to increase albeit at a more modest rate. It was the falling cereal prices, often below the cost of production, that caused farmers to switch to minimising costs rather than maximising production.

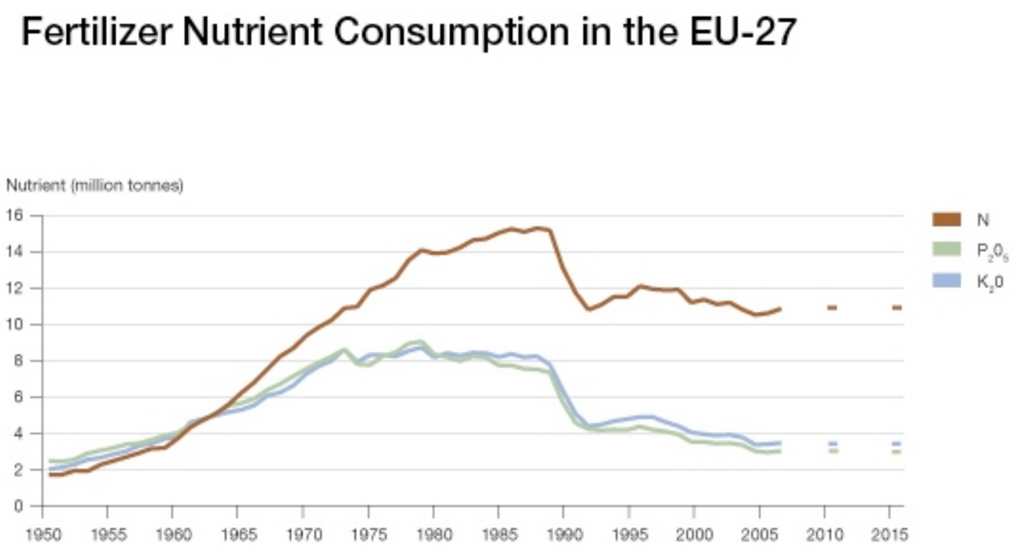


Figure 40: EU27 Fertiliser usage[116]

Subsequent changes in the CAP, principally the cross-compliance rules and new environmental legislation covering Nitrate Vulnerable Zones, have forced farmers to carefully ration their use of nitrogen fertilisers. Another important factor that is now causing farmers to improve the targeting of fertilisers is the soaring cost - caused largely by energy price increases.

FAO Comments on Fertiliser use in Western & Central Europe
Environmental regulations on water, air and soil quality will probably have an increasing impact on farming practices. Farmers have been requested to further improve nitrogen use efficiency. This trend is likely to continue and to influence regional demand downwards in the medium term.

Environmental regulations also mandate greater recycling of organic nutrient sources (e.g. animal manure and urban wastes) and implementation of nutrient budgeting which is likely to depress use of all nutrients particularly phosphate. Higher fertilizer prices, full implementation of the SFP and impact of environmental regulations are forecast to constrain fertilizer demand likely to increase slightly only because of demand growth in Central European countries.

Current world fertilizer trends and outlook to 2011/12 - FAO 2008

EU15 Projections – The yield projections to 2020 are illustrated in Figure 41 where the actual cereal yields are also shown for the 46 years from 1961 to 2006 along with the productivity curves.

The actual rate at which cereal productivity increases towards 2020 will depend upon the long term demand for the crop. Lower demand will hold down prices and slow down yield growth but high prices will encourage the application of better seed varieties, improved agronomy, better machinery and fertiliser to optimise yield growth.

The four projections shown in Figure 41 extend from 2006 to 2020 using Pre and Post McSharry trends, the 1% cereal trend as used in the DG AGRI scenario, and a projection that is described as the Sustainable trend. This is presumed to be the trend that will result from increased internal demand and the resulting drive for increased crop yields but restrained by the cross compliance and the economic constraint caused by high fertiliser prices.

The 46 year straight line trend from 1961 to 2006 is also projected forward that suggests that the Sustainable projection would bring yield growth back to the established linear trend.

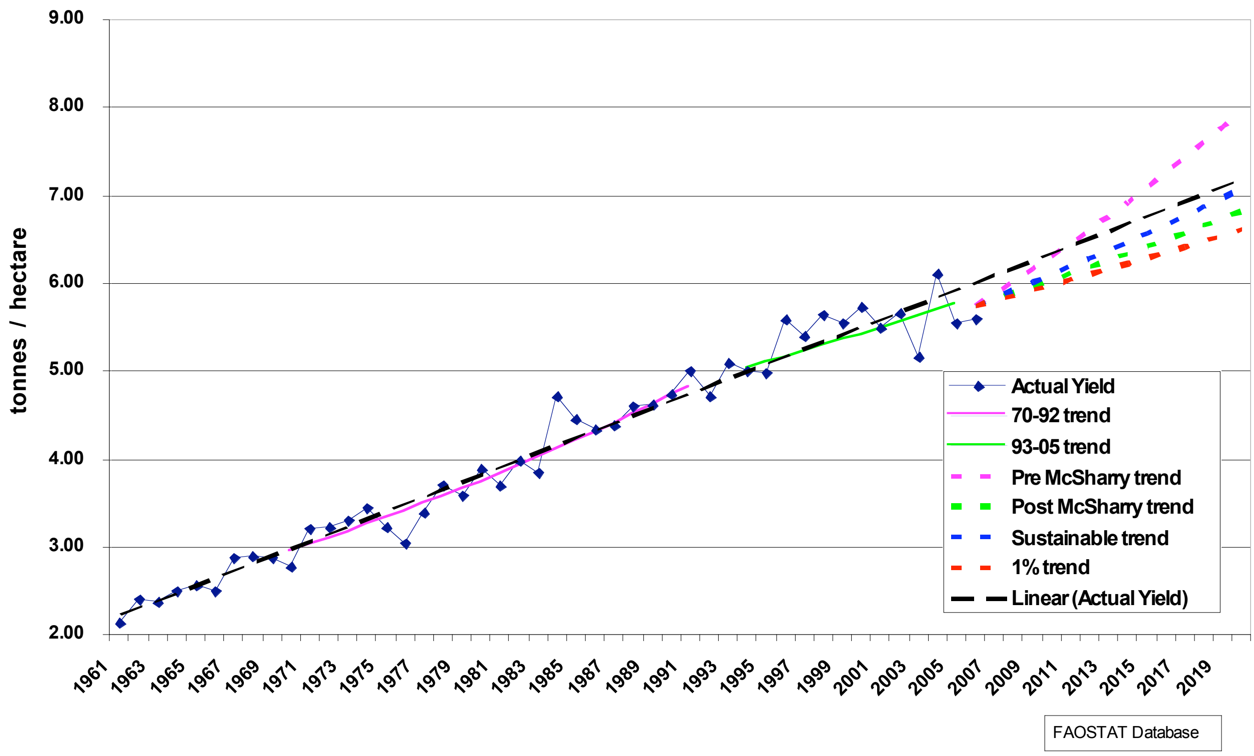


Figure 41: EU15 Cereal yield trends and projections

EU12 Cereal growth trends

As illustrated earlier in Figure 21 the rate of productivity growth within the new Member States lagged behind that of the EU15 from the early 1970's and fell back even further in the early 1990's. This collapse occurred during the political and economic uncertainties in the transition to independence. The economic shock hit both demand for cereals and the supply of essential items for crop production such as fuel, fertiliser and machinery parts.

The current 2 tonne per hectare disparity in productivity between the new Member States and the EU15 is not technologically justified despite differences in climatic conditions and soil types. The gap can be closed significantly by investment in suitable machinery and infrastructure; including roads, granaries, combine harvesters and grain driers - and the application of modern agronomy with better seed varieties, fertilisers and sophisticated disease and pest management. But the driver for productivity change will be the scale of demand - although in some countries land ownership structures may impede progress.

It is therefore assumed that the rate of productivity increase in the new Member States will outstrip that of the EU15 because they are starting from a low base and will benefit from improved infrastructure and technology transfer as new investors enter the agricultural sector in the new member states.

This "catch-up" rate of productivity increase was witnessed following the accession of Portugal, Spain, Greece and Ireland. In 1986, at the time Spain and Portugal acceded to the then EU, their GDP per capita (in power purchasing parity) were just 76% and 60% of the EU average of the then 12 Member States. That year, two other Member States also had significantly lower GDP per capita than the EU average: Greece (74%) and Ireland (66%)[117]

An assessment of their cereal productivity reveals that from the time that these 4 Member States ("EU-4") acceded, until the introduction of the McSharry reforms, their productivity grew substantially faster, at 3.2% per year, than the EU as a whole (2.3%), as would be expected for countries whose economies are stimulated from entry into the EU. (Precisely, the study has measured for each Member State the 5-year average of its cereal productivity leading to accession and the 5-year average immediately prior to the implementation of the McSharry reforms). See Table 29: Cereal productivity growth rates for new MSs from accession to 1992.

In 2006, the 12 latest entrants to the EU had a GDP per capita (in power purchasing standards) that ranged between 94% (Cyprus) and 37% (Bulgaria), with an average of 65%[118], which is equivalent to those of Ireland, Portugal, Greece and Spain in 1986. However, the three largest landed countries (Poland, Romania and Bulgaria) are those with the greatest amount of catching up to do.

The study therefore assumes that the new EU-12 Member States will achieve the same cereal productivity growth between now and 2020 as the poorer Member States of the 1980s.

Annual rate of cereal yield increase from EU accession until 1992	
Greece	0.43%
Ireland	3.30%
Portugal	7.20%
Spain	3.41%
Weighted average	**3.19%**

Table 29: Cereal productivity growth rates for new MSs from accession to 1992

This rate of 3.19% productivity increase is assumed in the (C) Max Bioethanol and (D) Max Biodiesel scenarios where cereal demand is high. In the (E) Sustainable yield scenario the EU12 productivity is pro rata to that of the EU15 (35% higher). In the (B) Zero Biofuel scenario the lack of demand will reduce agricultural investment and cause the growth rate to be the same as the EU15.

Crop Mix

In addition to the technological improvements within the various cereal types there will also be changes in the mix of cereal grown in response to the market demands for more wheat and maize. These are the highest yielding cereals which will tend to displace some of the lower yielding crops such as barley, rye and oats – thus contributing to improved average cereal yields.

Indeed the steady Northward movement of the maize growing area because of better seed varieties and global warming may accelerate the trend [62].

Crop mix

Climate change will lead to a corresponding change in cropping patterns. For example:

Warmer and wetter climate conditions in Northern Europe will progressively result in a longer growing season conducive to the continuing northward expansion of maize cropping.

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Annex 5: DDGS and other animal feeds

The main driver for producing bioethanol from crops is to provide the renewable transport fuel but, like other processing plants including oil refineries, the same plant turns out other co-products from the same feedstock. In the case of bioethanol from cereals the main co-product is known as Dried Distillers Grains & Solubles (DDGS), which are high protein feed ingredients especially suited for feeding to cattle but may also be fed in smaller proportions to pigs and poultry[119].

The bioethanol processor utilises feedstocks that contain starch and sugars to be fermented into alcohol. In the bioethanol production process the starch is converted to sugars and removed from the feedstock. The remaining constituents including protein, fibre, minerals, amino acids etc. are effectively concentrated in the process residues. In the case of cereals, where about 2/3rds of the mass is made up of starch the remaining constituents are concentrated to about three times their original value - so that wheat with 12% protein content could be concentrated to 36% in the process residue - DDGS[120].

EU Animal Feed Consumption
Within the EU-25, about 450 Mt of feedingstuffs are consumed by livestock each yea of which 215 Mt, mostly roughages are grown and used on the farm of origin. The balance, of 235 Mt of feed, includes cereals grown and used on the farm of origin (51 Mt) and feed purchased by livestock producers to supplement their own feed resources (either straights or compound feed).
FEFAC Feed Statistics 2006

The European animal feed compound industry currently consumes 144 Mt of ingredients per annum 40% of which are co-products from the food and seed-crushing industry. The largest feed sector is poultry feed at 50 Mt followed by pigs with 45 Mt and cattle feed at 38 Mt.

The breakdown of the main ingredient groups can be seen in Figure 42. In 2006 the EU imported 32 million tonnes of co-products including maize gluten, oilcakes and meals.

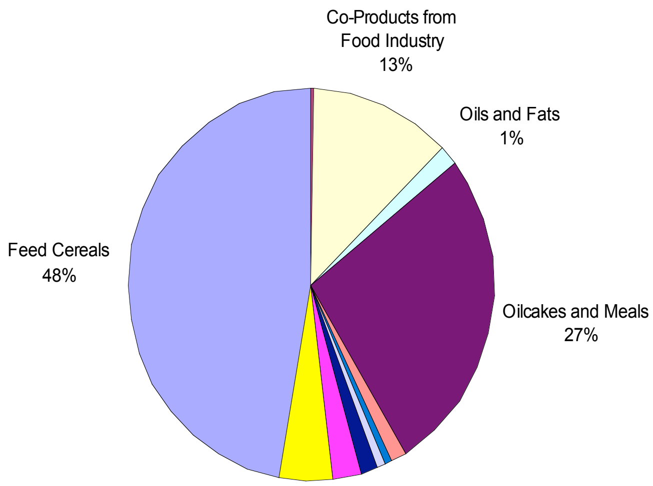


Figure 42: Animal feed ingredient proportions[121]

A bioethanol plant is a cereal refinery that produces a similar tonnage of DDGS to the production of bioethanol. In 2006 the EU bioethanol industry produced about one million tonnes of DDGS, based upon 2.6 million tonnes of cereals used.

The 2020 alternative scenarios assume that the EU bioethanol sector will produce the following tonnages of DDGS per annum.

	Scenarios				
	A	B	C	D	E
DDGS Production (Mt)	21.5	0.0	42.5	40.4	0.0

Table 30: DDGS production for each scenario

The scale of production is such that DDGS will have to be very competitive with other ingredients to displace them from the market. The primary market for conventional DDGS will be as a cattle feed ingredient where both its energy and protein components are most valuable.

Although DDGS is principally valued for its protein content it also is seen as a feed energy source so that its use reduces demand for cereals in animal feed. In Table 31 it can be seen that Wheat DDGS has 34% protein which is 2.6 times that of wheat but that the energy content for ruminant feeds is almost identical. However the energy value of wheat DDGS is 25% less than wheat in Poultry and Pig diets. Research is currently being conducted to improve the digestibility of DDGS in all types of livestock diets including pig and poultry.

	Maize	Maize DDGS	Wheat	Wheat DDGS
Protein (%)	9.6	28.0	13.0	34.0
Metabolisable Energy Ruminants) (MJ/kg)	14.5	14.8	13.8	13.7
Metabolisable Energy Poultry (MJ/kg)	16.0	12.9	15.1	11.1
Digestible Energy Pigs (MJ/kg)	17.1	12.3	16.0	12.0

Table 31: Nutritional values of cereals and DDGS[122]

In addition to the feed ingredients consumed by the EU animal feed compound industry 51 Mt[123] of cereals are consumed on the farm of origin.[124]

The study assumes that the DDGS will displace imported oilseed meals and cereal co-products such as feed Maize Gluten and Corn DDGS. It will also displace the use of cereals when it contributes to the energy content of cattle feed. The pattern of displacement is assumed to be in the following order -

5. Imported high protein cereal co-products such as Corn Gluten Feed and Corn DDGS.
6. The soya fraction that is currently used in cattle feed.
7. A proportion of the soya that is currently used in pig and poultry diets
8. The balance to replace cereals in cattle feed diets – this will be partly due the displacement of cereals grown and used "on-farm" by industrial feeds and straights that will include DDGS. The cereals would be then sold on the open market because cereal prices will be relatively higher than the compounds and straights.

It is assumed that DDGS will displace all 4 Mt of imported high protein maize co-products, 20% of DDGS will displace cereals and the balance will displace imported protein meals – principally soybean meal.

	Maize Gluten Feed	Distillers Grains (Wheat)	Soya Bean Meal (lo-pro)	Wheat
Dry Matter	88.00	90.00	88.00	86.00
Crude Protein	21.50	34.00	47.00	13.00
DCP	17.00	26.00	43.00	10.00
MER	12.90	13.70	12.90	13.80
MEP	9.10	11.10	10.70	15.10
DE	12.50	12.00	14.80	16.00
Crude Fibre	8.00	8.00	8.20	3.00
Oil (EE)	3.10	7.00	2.00	1.80
Oil (AH)	4.00	8.50	2.30	2.00
EFA	1.65	4.50	0.90	1.50
Ash	6.50	5.00	7.20	2.00
NCGD	73.20	80.00	84.20	93.50
NDF	42.50	40.00	16.10	12.00
ADF	9.90	18.00	8.00	2.60
Starch	22.00	5.00	4.50	67.00
Sugar	3.50	5.00	10.00	4.00
Starch + Sugar	25.50	10.00	14.50	71.00
Total Lysine	0.70	1.00	3.10	0.35
Avail Lysine	0.40	0.80	2.90	0.30
Methionine	0.50	0.55	0.70	0.21
Meth & Cysteine	0.90	0.90	1.50	0.45
Trytophan	0.15	0.30	0.90	0.15
Threonine	0.85	1.20	1.90	0.40
Argenine	1.10	1.20	3.60	0.60
PDIA	6.30	15.00	18.90	2.70
PDIN	14.80	25.50	34.80	8.20
PDIE	12.20	20.50	25.00	10.20
Met DI	0.25	0.40	0.40	0.19
Lys DI	0.65	0.90	1.80	0.20

Table 32: Nutritional value of wheat DDGS and other ingredients [119]

Annex 6: Details of alternative scenarios

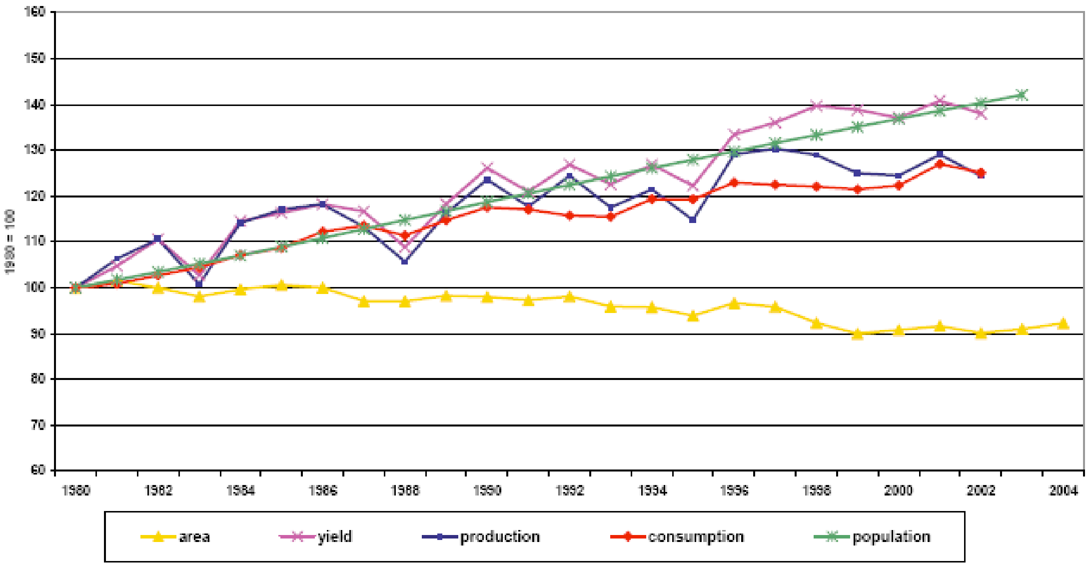
2020 Biofuel Scenarios	UNITS	A	B	C	D	E
		10% BIOFUEL - SCENARIO DG TRENS RENEWABLE ENERGY ROADMAP SEC (2006) 1721/2	ZERO BIOFUELS (1% CEREAL GROWTH RATE)	MAX 1st GEN EU BIODIESEL (PRE MCSHARRY CEREAL GROWTH RATE)	10% BIOFUELS - SUSTAINABLE CEREAL GROWTH RATE	10% BIOFUELS ALL IMPORTS
Ethanol from cereals	Mtoe	12.7	0.0	27.2	25.8	0.0
Ethanol from sugar beet	Mtoe	0.8	0.0	0.8	0.8	0.0
Biodiesel from oilseeds	Mtoe	4.7	0.0	16.7	4.5	0.0
Bioethanol from straw	Mtoe	5.0	0.0	0.0	0.0	0.0
BTL	Mtoe	2.5	0.0	0.0	0.0	0.0
Bioethanol imports	Mtoe	0.3	0.0	0.0	0.0	14.0
Biodiesel & feedstock imports	Mtoe	5.0	0.0	0.0	0.0	17.1
Proportion bioethanol	%	61%		63%	85%	45%
Proportion biodiesel	%	39%		37%	15%	55%
TOTAL BIOFUELS	Mtoe	**31.0**	**0.0**	**44.7**	**31.2**	**31.0**
Forecast transport fuel demand - 2020	Mtoe	310	310	310.0	310.0	310.0
BIOFUEL %	%	**10.0%**	**0.0%**	**14%**	**10%**	**10%**
CROP PRODUCTION						
Cereal production	Mt	309.6	326.7	389.2	396.3	326.7
Cereal for biofuel	Mt	60.9	0.0	118.4	112.5	0.0
Sugar beet production	Mt	17.0	17.0	17.0	17.0	17.0
Sugar beet available for biofuels	Mt	2.3	0.0	2.3	2.3	0.0
Oilseed production	Mt	37.8	33.4	71.4	37.1	33.4
Oilseed available for biofuels	Mt	13.46	0.00	47.1	12.8	0.0
ASSUMPTIONS						
Ethanol yield from cereals (w/w) in 2020	%	32%	33%	33%	33%	33%
Ethanol yield from sugar beet w/w 2020	t/ha					
Biodiesel yield from oilseed rape w/w 2020	%	39%	40%	40%	40%	40%
EU 15 cereal yield 2006	t/ha	4.98	5.76	5.76	5.76	5.76
EU 12 cereal yield 2006	t/ha	3.00	3.67	3.67	3.67	3.67
Sugar beet yield per hectare 2006	t/ha					
Oilseed yield per hectare 2006	t/ha	3.00	3.00	3.00	3.00	3.00
Setaside / idle area 2006	Mha	7.20	7.20	7.20	7.20	7.20
Cereal Exports	Mt	6.90	84.89	29.0	42.00	84.89
SCENARIO VARIABLES						
Setaside utilisation	%	53%	-50%	50%	50%	-50%
Ratio of DDGS to cereal ethanol	%	108%	100%	100%	100%	100%
DDGS substitution rate for cereals	%	0%	20%	20%	20%	20%
Veg oil to biodiesel	%	98.0%	98.0%	98%	98%	98%
Cereal yield trend EU 15	%	1.00%	1.00%	2.37%	1.50%	1.00%
Cereal yield trend EU 12	%	1.00%	1.00%	3.19%	2.03%	1.00%
Sugar Beet yield trend	%	2.00%	2.00%	2.00%	2.00%	2.00%
Oilseed yield trend	%	2.00%	2.00%	2.00%	2.00%	2.00%
Land allocated to cereals	%	86.8%	87.0%	75.0%	87.0%	87.0%
Land allocated to oilseeds	%	13.2%	13.0%	25.0%	13.0%	13.0%
Arable land in EU 15 vs EU 12	%	65.0%	65.0%	65.0%	65.0%	65.0%
LAND Allocation 2020						
Cereal area	Mha	62.83	56.52	54.13	62.79	56.52
Oilseed area	Mha	9.55	8.45	18.04	9.38	8.45
Arable land in EU 15	Mha	72.39	64.97	72.17	72.17	64.97
Sugar beet area 2020	Mha	1.43	1.43	1.43	1.43	1.43
Idle land	Mha	3.38	10.80	3.60	3.60	10.80
Other crops	Mha	36.60	36.60	36.60	36.60	36.60
Total arable area	Mha	113.80	113.80	113.80	113.80	113.80
LAND USE CHANGE FOR 2020						
Cereal area change	Mha	3.83	-2.48	-4.87	3.79	-2.48
Oilseed area change	Mha	0.75	-0.35	9.24	0.58	-0.35
Total cereal & oilseed area change	Mha	4.59	-2.83	4.37	4.37	-2.83
Sugar beet area change	Mha	-0.47	-0.47	-0.47	-0.47	-0.47
Idle land change	Mha	-3.82	3.60	-3.60	-3.60	3.60
Total other crops change	Mha	-0.30	-0.30	-0.30	-0.30	-0.30
Total arable area change	Mha	0.00	0.00	0.00	0.00	0.00
CEREALS						
Yield per hectare	t/ha	4.93	5.78	7.19	6.31	5.78
Price based upon export balance	€/t	130.74	111.62	125.32	122.14	111.62
Earnings per hectare	€/ha	644.25	645.20	901.16	770.97	645.20

Annex 7: World grain productivity

The finite area of the world's 1.5 billion hectares of agricultural land is one of the limiting factors for the production of crops for food, feed and biofuels. The others; climate, water, soil nutrients, pests and diseases all come together to influence yield per hectare – productivity. But the yield limitations imposed by nature are mitigated by careful application of agricultural technology – farming - the results can be seen in the cereal productivity record.

Historically cereal productivity has been increasing at faster rates than food demands from the rising world population and improving living standards. The resulting oversupply causes excessive stocks and forces down prices; and production. The net effect is to keep cereal production increases in line with increased cereal demand.

Figure 43 shows world population rising by about 42% between 1980 and 2004 whereas, cereal consumption and production increased by 25%. Because there was insufficient cereal demand, production was trimmed back and 8% less land was needed to produce the crop required. The yield trend was almost identical to the population trend.



Source: FAOSTAT

Figure 43: World total cereal growth 1980 to 2004

The ultimate biological limit for yields per hectare is set by the maximum rate of photosynthesis and that is dependent upon the climatic region. The maximum yield potential for biomass is in the tropics where the photosynthetic capacity is estimated to be 90 t/ha, compared to the world average for cereals and straw of less than 10 t/ha. In Western Europe it has been estimated that the yield potential for wheat in rain fed conditions is between 14.0 t/ha and 18.3 t/ha plus the straw that should provide at least a further 7 t/ha of straw.[125]

Species	Yield units	Current yield (UK farm average)	Potential yield	
			Irrigated	Rainfed
Wheat	t/ha/yr	8.0	19.2	14.0 – 18.3
Oilseed rape	t/ha/yr	3.0	7.93	4.02 - 7.93

Figure 44: Wheat & rapeseed yield potential[126]

To optimise for productive capacity the limiting factors must be addressed in order of local importance. Agriculture can use the whole breadth of technology from the most advanced computer assisted systems to the traditional farming practices that have evolved over thousands of years. These include -

Satellite and aerial photographic mapping to monitor crop condition

Soil analyses to ensure optimum micro-mineral balances

GSP guidance systems for farm machinery to target application of soil and crop treatments

Fertilisers and soil conditioners to balance nutrients

Crop rotation to reduce nutrient depletion and control pests and diseases

Water storage for irrigation

Machinery that allows crops to be planted with the minimum tillage

Biological and chemical treatments prevent and combat crop diseases

Seed breeding for

- disease resistance
- pest resistance
- drought resistance
- salt tolerance
- improved canopy area (i.e. more surface area for photosynthesis)
- balance of biomass – (e.g. ratio of seed to straw in cereals)

Technologies are constantly evolving to push back crop yield limitations and achieve higher levels of productivity. Research and Development, and the application of the resulting technologies thrive, when there is confidence to invest. But investors are motivated by the potential financial return from a market that is often demand constrained.

Agricultural productivity is not an issue simply for farmers, it is important for society as a whole for the supply of food, feed and biofuel feedstocks. So it is important that public policy is designed to stimulate continued R&D and the exploitation of new technology. These can be best achieved by developing new markets that will allow agriculture to exploit its potential in a market environment that will have a more stable supply and demand balance, and less price volatility.

Annex 8: Genetic Reduction in Energy use and Emissions of Nitrogen from cereals[127]

The GREEN Grain project is an excellent example of how research and development for crops can provide benefits for all grain users and producers. The project was established by commercial and academic organisations in 2004 and received funding from the UK ministry of Agriculture (DEFRA) and the Home Grown Cereal Authority (HGCA) which is financed by levies from UK grain growers. It aims to produce wheat with higher starch yields, reduced nitrogen fertiliser requirements and low levels of indigestible protein so that when fed to poultry it produces less nitrogen oxide emissions from litter.

Historically the focus of wheat breeding in the UK has been on yield and bread-making quality. The result has been high fertiliser usage to achieve the former, and high grain protein content to achieve the latter. The non-ruminant feed and distilling markets both require grain with high starch rather than high protein, and the emerging bioethanol industry has similar demands.

This project aims to explore the potential to develop wheat varieties with enhanced value for distilling (both bioethanol and potable alcohol production), non-ruminant feeding and other end-uses, and with reduced production costs. The research will identify genes and processes giving rise to high starch grains with high ethanol yields, improved amino acid balance, reduced gliadin proteins and reduced requirements for fertiliser N by

- developing screening techniques, e.g. new NIR calibrations for energy content,
- screening current varieties and elite germplasm,
- developing mapping populations and genetic markers for these characters,
- examining associations between target characters and existing indices of crop performance, e.g. yield, and
- assessing agronomy and end-use value of the high-energy lines in the bio-energy and poultry industries.

It appears feasible to combine these different attributes in one wheat type because:

- The biofuels and livestock feeding industries both regard wheat primarily as an energy source. Thus their principal requirements are similar.
- It is likely that exploitable variation for the individual characters exists in the elite gene-pool, given the absence of past selection, and given the evidence that it exists in the adapted gene-pool (from which modern varieties have been bred).
- The gliadin proteins in the endosperm of wheat grain are very low in lysine and other essential amino acids, so have minimal nutritional value to non-ruminants.
- When gliadins are minimised by breeding, grain starch should increase proportionally and N demand should reduce by 30%.

- Considerable 'inactive' N is contained in true stems. When used as a breeding target, low stem N should reduce canopy N content by 30%, without affecting photosynthesis.
- A 30% reduction in crop N uptake should give a 50% reduction in fertiliser N.

It is expected that varieties identified here, or varieties which are bred from the materials developed here, will provide end-users with grain of enhanced value, and also growers with better returns. This is partly because availability of high-energy varieties will expand the market for UK wheat, particularly for bioethanol production, partly because high-energy wheat will need less fertiliser (and other inputs) than conventional wheat, and partly because on-farm energy use and downstream pollution will be reduced. There will also be significant benefits to the distilling and livestock industries, both in terms of cost savings, and reduced N pollution.

Figure 45 illustrates the price trend in relation to the scale of exports – derived from Table 5 of the Biofuel Progress Report. The difference between import parity and export parity is illustrated in red with the dotted red line illustrating the way that prices would trend upward as Europe imported more from the world market. The vertical change in price, illustrated by the solid red line, occurs as Europe switches between import and export parity and is theoretically linked to the cost of the freight. This cost will depend upon the source of the nearest grain surplus that can fill the EU shortfall.

Annex 9: EU grain prices in relation to exports and imports

Figure 45 shows the price trend in relation to the level of export surplus as derived from table 5 of the Impact Assessment for the EU Biofuel Progress Report

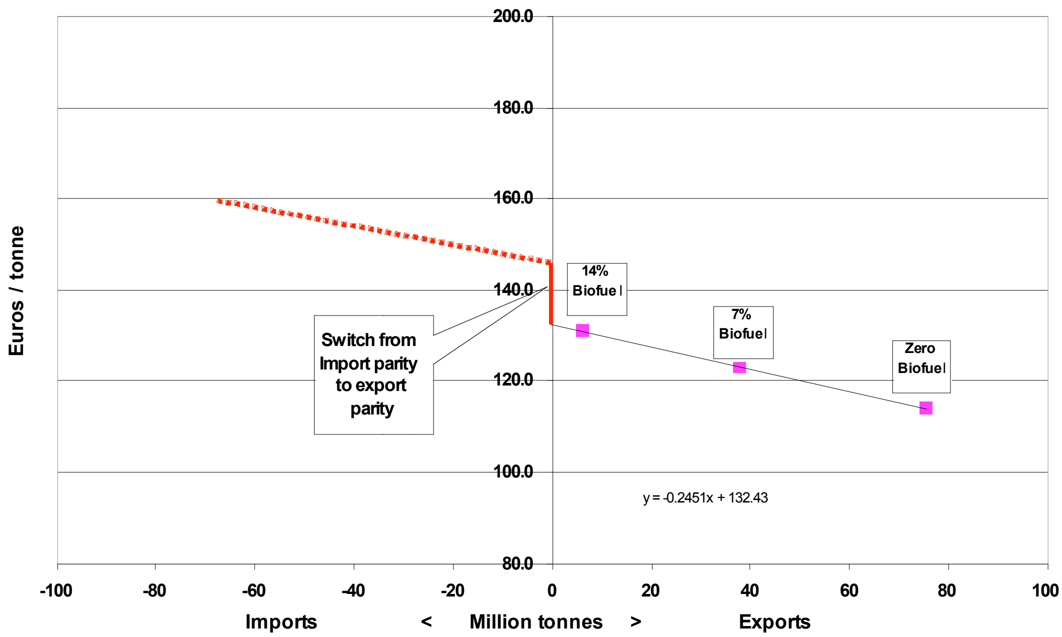


Figure 45: Cereal price related to exports[32]

Grain prices and exports

The de-coupling of CAP payments from cereal production, the reductions in intervention support prices, the elimination of intervention stocks and the reduction in the range of supported cereals ensures that from 2006 internal EU prices are more sensitive to world market prices.

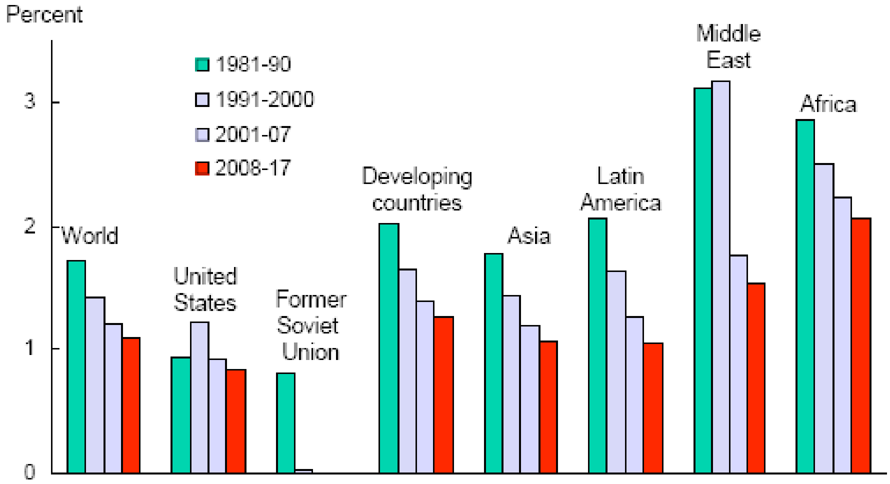
But internal prices will be further influenced by the EU's supply/demand balance. When EU cereal market is in surplus then internal grain prices will be based upon Export Parity - the price that will have to compete at the port of exit with the cheapest alternative supplies to the export destination. Whereas if the EU has a cereal deficit then internal prices will be based upon Import Parity – prices will be based upon the cost of transporting the cheapest grain into Europe.

The price swing from Export Parity to Import parity will depend upon comparative logistic costs for example comparing shipments from the US with road transport over the Ukraine border. But these costs are further distorted by the border tariffs for some cereals when they enter Europe or exit countries where they impose export taxes.

Annex 10: Food markets demand constrained

(extract from USDA Long-term Projections, February 2008)

Population growth continues to slow



Source: Population projections, U.S. Department of Commerce, U.S. Census Bureau.

A continued slowing of population growth around the world is an important factor limiting increases in food and agricultural demand over the next decade. World population growth declines from an annual rate of 1.7 percent in the 1980s to an average of about 1.1 percent per year for the projection period.

Developed and FSU countries have very low projected rates of population growth, at 0.4 percent and 0.1 percent, respectively. The projected annual average population growth rate for the United States is the highest among developed countries, at 0.9 percent, in part reflecting large immigration. Population growth rates in developing economies decline by more than 40 percent between the 1980s and the end of the projection period, but remain above those in developed countries and the FSU. As a result, the share of world population accounted for by developing countries increases to 84 percent by 2017.

China and India together account for more than one-third of the world's population. China's population growth rate slows from 1.5 percent per year in 1981-90 to 0.6 percent in 2008-17. The population growth rate in India, the world's second most populous nation, is projected to decline from 2.1 percent to 1.5 percent per year between the same periods. The differential in population growth narrows the gap between India's and China's populations.

Brazil's population growth rate falls from 2.1 percent per year in 1981-90 to 0.8 percent annually in 2008-17. Sub-Saharan Africa's population growth rate declines from 2.9 percent to 2.2 percent per year between the same periods, leaving this impoverished region with the highest population growth rate in the world.

There are a number of countries with declining populations. Most of these are mature economies such as Japan and countries in Western Europe, Central Europe, and the FSU. However, several countries in Sub-Saharan Africa have declining populations resulting from the AIDS epidemic, including the Republic of South Africa, Botswana, Lesotho, and Swaziland.

Annex 11: Rural land rights

When evaluating suitable biofuel partners in developing countries the national availability of land does not necessarily mean that an agricultural development programme and supply relationship will benefit those in those in poverty. [128]

The issues of land rights can also be critical to ensure that there are long term benefits to the farmers' families from improving the productive capacity of the soil. *"Land rights represent the single greatest asset for the world's rural poor"*[129]

> *"agriculture has little impact on poverty decline when land distribution is highly unequal – usually associated with absentee landlords who have quite different consumption patterns from those of peasant farmers"*
>
> **World Trade and Food Security – FAO 2006**

Land ownership has long been linked with improvement of the productive capacity of the land as evidenced from an old farming ambition *"to hand on the land to my children in better condition than when I took it on from my father"* Figure 46 illustrates that soil improvement and enhanced water developments will only occur when there are high levels of land security.

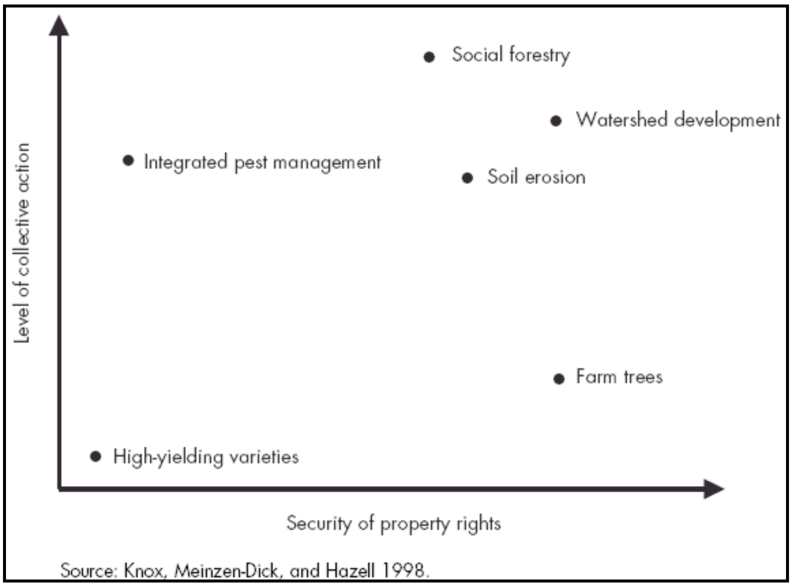


Figure 46: Links between property rights and technology adoption[130]

The Rural Development Institute is a non profit making group that claims to have secured legal land rights for 100 million hectares for 105 million rural families in forty countries across the world with the main beneficiaries being in China, Ukraine, South Vietnam, Russia and the Philippines. They state *"from land insecurity to land ownership—has boosted agricultural productivity in the developing world by billions of dollars per year, and placed scores of billions of dollars in new land wealth in the hands of the rural poor."*

To reduce poverty in the developing world polices that address land ownership issues need to be an integral part of any biofuel and agricultural development partnership.

[1] Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources – COM(2008) yyy final

[2] FOA Food Outlook - 2007Crop: US (420 Mt), China (394 Mt), Europe (261 Mt) and India (203 Mt)

[3] Working definitions of food security and insecurity "Trade Reforms and Food Security - Conceptualizing the Linkages" FAO – Rome 2003

[4] What global price rises mean for WFP – World Food Programme - http://www.wfp.org/english/?ModuleID=137&Key=2797

[5] The Global Food Crisis – Financial Times, April 13 2008 - http://www.ft.com/cms/s/0/d8184634-07cc-11dd-a922-0000779fd2ac.htmls

[6] **GENEVA, Switzerland**, April 28, 2008 (ENS) - The United States and the European Union have taken a "criminal path" by contributing to an explosive rise in global food prices through using food crops to produce biofuels, the United Nations special rapporteur on the right to food said today. At a press conference in Geneva, Jean Ziegler of Switzerland said that fuel policies pursued by the U.S. and the EU were one of the main causes of the current worldwide food crisis. http://www.ens-newswire.com/ens/apr2008/2008-04-28-03.asp

[7] FAOSTAT and International Grains Council

[8] USDA and FAOSTAT

[9] Chart developed by Alistair Dickie, Crop Marketing Director, HGCA using IGC, USDA and HGCA data.

[10] FAOSTAT Database

[11] HGCA Market Prospects Vol10 Issue 06 September 2007

[12] Adapted from the World Agricultural Production Report–WAP 07/09 - USDA

[13] 332.09 Mt in 2007 and 267.60 Mt in 2006 - USDA World Agricultural Production Report – May 2008

[14] World Agricultural Production Reports – May 2006 and July 2006

[15] Food Prices and protests: Taking the strain -Economist – 8th May 2008

[16] World Bank President Welcomes Ukraine Lifting Of Grain Export Restrictions – World Bank press release 24th April 2008

[17] Soaring freight costs add to price of basics – Financial Times May 15 2008

[18] Disentangling the links between the Fed, the falling dollar and the soaring price of the world's commodities. Economist 1st May 2008

[19] FO Licht's World Ethanol and Biofuels Report – Vol 6 No.15 - 09/04/2008 & Prospects for Agricultural Markets an Income in the European Union 2007-2014 –DG AGRI - March 2008

[20] Based upon FAO Food Price Index (Cereals) Jan to Mar 2007 compared to Jan to March 2008.

[21] Equal to the US increase of maize production between 2006 and 2007.

[22] U.S. Department of Agriculture's National Agricultural Statistics Service (NASS) Jan 11 2008

[23] FAO Food Outlook – Global Market Analysis – November 2007

[24] FAO Food Outlook – Global Market Analysis – November 2007

[25] Matif futures market, Paris - Prices as reported by HGCA

[26] Other cereals are used such as barley, maize and rye but as they are also used for animal feed, where they can be substituted for each other, their prices maintain a tight relationship with wheat

[27] Futures markets provide the most transparent grain price that tends to be used as the benchmark for grain trading but their price movements will tend to be more extreme than the resulting "farm-gate" and "delivered mill" prices.

[28] HGCA Market Data Centre http://data.hgca.com/default.asp

[29] Disposals equal EU cereal usage plus exports from the EU.

[30] Prospects for Agricultural Markets an Income in the European Union 2007-2014 –DG AGRI - March 2008

[31] Biofuel Progress Report – Review of economic and environmental data for the biofuel progress report – SEC(2006) 1721/2

[32] The formula was derived from prices given in the Biofuel Progress Report Table 5. The price relationship with exports shows a base price of €132.43 per tonne for cereals when there is no surplus to export and the price reduces by €0.245 per tonne for every million tonne of surplus. Or it can be used as an index that shows cereal prices reduce by 0.185% for each one million tonne of cereal surplus.

[33] Set aside cereals for intervention 2005 (592,000t) and 2006 (700,000t) are estimates in a personal communication from DG AGRI dated 16th May 2008. The 2007 figure of 800,000t continues the trend of the previous year and is supported by statistics from Abengoa Bioenergy that alone increased set aside cereal usage for bioethanol by 49,000 tonnes. Personal communication from Ecoagricola - 9th May 2008.
[34] UK HGCA
[35] Russell Mildon, Director of Economics, DG AGRI - Impact of Biofuels on Commodity Markets – Sep 2007.
[36] Russell Mildon, Director of Economics, DG AGRI - Impact of Biofuels on Commodity Markets – Sep 2007.
[37] Food prices have risen faster than justified, argues Brussels Financial Times 30th April 2008 http://www.ft.com/cms/s/0/88effd62-1641-11dd-880a-0000779fd2ac,dwp_uuid=a955630e-3603-11dc-ad42-0000779fd2ac.html

[38] UN says oil rise hits food prices harder – Financial Times 28th April 2008 http://www.wfp.org/english/?ModuleID=137&Key=2797

[39] US farmers mount defence of biofuel industry - FO Licht's World Ethanol & Biofuels Report - May 02 2008
[40]

EU document source	7%	10%(a)	10%(b)	14%(a)	14%(b)
	SEC(2006) 1721/2: Jan 07	SEC(2006) 1719: Jan 07	AGRI G-2D (2007) Apr 07	SEC(2006) 1721/2: Jan 07	SEC(2006) 1721/2: Jan 07

[41] This export level has been taken from the forecasts used in Prospects for Agricultural Markets and Income in the European Union 2007-2014 (March 2008). It is assumed that by maintaining this level of exports the EU biofuel policy will then have a neutral impact on the world grain markets.
[42] Press report http://www.auto-motor-und-sport.de/magazin/service/kataloge_-_listen/hxcms_article_510043_13987.hbs
[43] European Vehicle Parc 2006 – Anfac (Asociación Española de Fabricantes de Automóviles y Camiones) - January 2008
[44] Review of economic and environmental data for the biofuels progress report – SEC(2006) 1721/2
[45] See list of world car manufacturers and their policy statement on E10 blends at US Renewable Fuels Association Website http://www.ethanolrfa.org/
[46] Eurostat database
[47] Ford alone claimed to have sold 40,000 FFV Focus cars by 2007. Ford forecast s that total FFV sales in Europe will be 100,000 in 2009 – Presentation by Ford Europe "Reducing Emissions from road transport – a car industry perspective" World Biofuels – May 2008
[48] The Swedish rate from 2001 to 2007 as confirmed by BEST. The Brazilian rate reached 90% within 5 years from 2003 to 2008 an exponential growth of 55% per annum.
[49] 139.5 Mtoe of petrol *85% * 80%
[50] Presentation by Joel Velasco of UNICA – May 2008
[51] Presentation by Luiz Carlos Correa Carvalho of Canaplan - World Biofuels – May 2007
[52] Sugar traders ED&F Man in interview with Bloomberg 24/10/2007
[53] Presentation by Joel Velasco of UNICA – May 2008
[54] Presentation by Joel Velasco of UNICA – May 2008
[55] Historic data from FOASTAT and own forecasts based upon 4 yield trends

[57] Novozymes - personal communication - Aug 2007
[58] Because oilseed yields less than half of the tonnage per hectare compared to cereals and so the price needs to be more than double that of cereals to provide the same gross margin per hectare. In practice this very rarely occurs.
[59] Based upon average allocation of oilseed for oilseed/cereal/set-aside area projected in Prospects for Agricultural Markets and Income in the European Union 2007-2020 (March 2008)
[60] Oilseed Rape Growers Guide - HGCA - 2005
[61] Prospects for Agricultural Markets and Income in the European Union 2007-2014 (March 2008)
[62] SCENAR 2020 – Scenario study on agriculture and the rural world – DG AGRI – Dec 2006
[63] Biofuel Progress Report SEC(2006) 1721/2
[64] Biofuels in a European Context – EC JRC - 2008

[66] Benchmark of €124.00/t for common wheat from table 5 in Review of economic and environmental data for the biofuels progress report – SEC(2006) 1721/2
[67] European Commission SEC(2006) 1721/2 - Biofuels Progress Report - Review of economic and environmental data for the biofuels progress report
[68] This effect was illustrated in 1996 in the USA following the 1995/96 price spike that led to a 20% fall in bioethanol production as smaller plants failed and the industry then took 3 years to recover to the 1995 level despite the low grain prices. During 2006/07 and 2007/08 European cereal demand for bioethanol reduced as prices rose causing at least three major plants to be temporarily "mothballed", others plants to run at low levels of utilisation and new projects to be abandoned.
[69] Impact of an increased biomass use on agricultural markets, prices and food security: A longer-term perspective - Josef Schmidhuber **–** Nov 2006
[70] The response time from the price signals influencing growers to the arrival of new grain supplies depends upon the time of year that the prices rise. If they increase just after the planting season then it will take up to 21 months before the increased harvest is available.
[71] Impact of an increased biomass use on agricultural markets, prices and food security: A longer-term perspective - Josef Schmidhuber **–** Nov 2006
[72] Evidence to the UK Renewable Fuels Agency on the indirect impact of Biofuels – HGCA - April 2008
[73] Dow Jones Newswires, May 13th, 2008
[74] Wall Street Journal, March 24th, 2008

[75] When the EU cereal market is in surplus then internal grain prices will be based upon **Export Parity** - the price that will have to compete at the port of exit with the cheapest alternative supplies to an export destination. Whereas if the EU has a cereal deficit then internal prices will be based upon **Import Parity** – prices will be based upon the cost of transporting the cheapest grain into Europe. The size of the price swing from Export Parity to Import parity will depend upon comparative logistic costs - for example importing US shipments would create a greater price swing than simply importing by road or rail across the Ukrainian border. But these costs are further distorted by the border tariffs for some cereals when they enter Europe or exit countries where they impose export taxes.

[76] Eurostat Database
[77] *"Our planet produces enough food to feed the entire planet. But tonight 854 million men, women and children will go to sleep on an empty stomach."* Jacques Diouf Director General (FAO) on World Food Day Oct 2007
[78] World Bank – World Development Report 2008 - Agriculture and Development
[79] World Bank – World Development Report 2008 – Agriculture and Development
[80] World Development Report 2008 – Agriculture for Development – World Bank
[81] USDA
[82] USDA
[83] FOA Food Outlook – Nov 2007
[84] A forward looking analysis of export subsidies in agriculture. OECD. 2002.
[85] World Agriculture - Towards 2015/2030 - An FAO Perspective
[86] World Agriculture: Forward to 2015/2030 – An FAO Perspective
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[106] Provided that sufficient biomass is left on the crop land to maintain soil condition,
[107] Additional income from surplus straw increases the growers' gross margin per hectare; incentivising further cereal production and increasing overall cereal supply. The increased cereal supply tends to put downward pressure on grain prices but, because the additional cash crop, from the same land area, lowers the farmer's break-even level, he can sustain the lower grain prices – in the same way that higher grain yields have helped the long term downward trend in real grain prices.
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