Stabilisation of the grain market by the flexible use of grain for bioethanol

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Stabilisation of the grain market by the flexible use of grain for bioethanol

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This report reviews whether the grain market and grain price can be stabilised by the variation of the use of grain in the EU-27's production of bioethanol. The time horizon of this study is 2020, whereby account is taken of the minimum 10% obligation for biofuel use in the EU-27. An economic computational model was used to develop a baseline scenario and a number of alternative scenarios for 2020. The alternative scenarios assume the use of a larger or smaller quantity of grain than in the base scenario for the EU-27's production of bioethanol. This variation depends on the availability of grain as compared to the baseline scenario. The effect of this variation on the grain price is then examined.

This research has been carried out by commission of the Product Board Arable Products.

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Preface

The reason for this study was the high volatility of prices, including grain prices, in recent years. Grain prices reached extremely high levels in 2007/2008: some even referred to a food crisis. In 2008, this situation resulted in a reduction of the planned incorporation of biofuel in the Netherlands since the biofuel obligation would result in a further increase in demand and, consequently, in the grain prices. However, in spite of the biofuel incorporation obligation the average grain price approached the intervention price level in 2009. The EU-27's grain intervention system will be amended from 2010. It is expected that this will increase price volatility. For this reason the grain chain is of the opinion that a new market instrument, tailored to the times, is required. The Commodity Board for Arable Products (PA) requested that LEI carry out a study of the feasibility of stabilising the grain price by varying the use of grain in the EU-27's production of bioethanol.

The study was carried out by J.F.M. Helming (Project Manager), A. Pronk and G. Woltjer. Mr R. Jongeneel (LEI) carried out an internal assessment of the report and submitted comments. The LEI project team was also assisted by an advisory committee comprised of Messrs T. Wuisman (Intergrain), F. Klein (PA), J. Haanstra (LTO), J. Kloos (LTO), K. Hoekstra (NAV) and M. Elema (PA). The project team and advisory committee met on a number of occasions. On behalf of the project team I would like to express my sincere gratitude to the members of the advisory committee for their contributions.

Prof. Dr R.B.M. Huirne
Managing Director Wageningen LEI

Summary

One of the problems confronting the grain chain is the grain price volatility that has been observed in recent years. This is detrimental to the optimum deployment of the scarce means of production for the production of and trade in grain and grain products. In addition, the grain intervention system will be amended on 1 July 2010. As a result, the grain price could fall below the current intervention price for a shorter or longer period of time. A grain surplus or deficit can result in strong price fluctuations. Since grain prices play a pivotal role, fluctuations in the grain price can also affect prices in other sectors of the agricultural sector.

The European Union adopted its biofuel policy, what is referred to as the 'Biofuels Directive' in May 2003 (EU, 2003). This Directive provides for the obligation to incorporate biodiesel and bioethanol in fossil fuels used for road transport. This incorporation obligation will be introduced in phases. The EU's biofuel policy is based on the obligation to incorporate a minimum of 10% biofuel in 2020. Bioethanol is produced from raw materials including grain and then, in particular, soft wheat and maize.

The objective of this study was to obtain an insight into the feasibility of stabilising the grain market and grain prices by varying the use of grain in the EU-27's production of bioethanol. In addition, the objective of this study was to obtain insight into the effects of the aforementioned stabilisation of the grain market on the markets for other agricultural products, bioethanol, by-products from bioethanol and cattle feed.

This question was answered by reviewing the current situation on the grain market and the bioethanol market. This was followed by the formulation of a potential scenario for prices and quantities on the grain market and bioethanol market in 2020, the 2020 baseline scenario. In addition, a number of alternative scenarios were examined in which a larger or smaller quantity of grain is used in the EU-27's production of bioethanol, depending on the grain availability as compared to the 2020 baseline scenario. LEI's LEITAP model was used to quantify the prices and quantities incorporated in the 2020 baseline scenario and the alternative scenarios. LEITAP is a model of international trade in agricultural products, energy and other products.

The 2020 baseline scenario is based on the obligation to incorporate at least 10% biofuel in fuels for road transport. The 2020 baseline scenario as-

sumes a grain price of €140 per tonne. The alternative scenarios explore situations that differ from the 2020 baseline scenario in that there is (a) a grain surplus and, consequently, a fall in grain prices or (b) a grain deficit and, consequently, a rise in grain prices. The assumptions made determine that stabilising the grain price by varying the amount of grain used in the EU-27's production of bioethanol will ultimately result in higher or lower EU-27 bioethanol imports.

The net production of grain is estimated at about 260 million tonnes in the 2020 baseline scenario (Table S1), lower than in recent years. The net production of grain is decreasing due to a decline in the EU-27's internal use of grain for both human consumption and cattle feed. This is in turn resulting in a decline in the area of agricultural land allocated to grain. The 2020 baseline scenario assumes a nominal grain price of €140 per tonne.

Table S1 shows that imports of bioethanol in the 2020 baseline scenario amount to a maximum equivalent of 18.7 million tonnes of grain. Moreover, in the 2020 baseline scenario more than 29 million tonnes of grain are used for the EU-27's production of bioethanol (Table S1). The use of grain in the EU-27's production of bioethanol and the EU-27's bioethanol imports in the 2020 baseline scenario increase greatly from the levels in the observed situation in 2008 (Table S1). This large increase is entirely due to the EU-27's biofuel policy based on the incorporated obligation of at least 10% biofuel in fuel used for road transport in 2020.

Table S1 Observed situation in 2008 and calculated situation in the EU-27 in the 2020 baseline scenario

	2008	2020
Net production of grain (million tonnes)	302	260
Use of grain in EU-27 bioethanol production (million tonnes)	6.2	29.3
EU-27 bioethanol imports in grain equivalents (million tonnes)	2.8	18.7

Source: LEITAP.

The alternative scenarios assume that the grain yield per hectare is either 5% higher or 5% lower than in the 2020 baseline scenario. In addition, a scenario is explored in which the grain yield per hectare is 10% higher than in the 2020 baseline scenario. These percentages have not been selected at random: to date, a 5% variation in the yield per hectare has occurred once every 3 years and a 10% variation once every 20 years.

When the grain yield per hectare is 5% higher in an alternative scenario and the total supply of grain in the EU-27 is also 5% higher than the standard in the 2020 baseline scenario, this will result in an extra supply of about 13 million tonnes of grain (5% of 260 million tonnes of grain). In the first instance, this will result in a decline in the grain price. This decline in price will be attenuated by market forces in the grain market such as an increase in exports of grain and an increase in the use of grain in the EU-27's production of ethanol. As a result, the grain price will stabilise at a lower level. Without additional measures a 5% increase in the supply of grain will result in a decline in price of approximately 8% (Table S2).

Additional measures are then implemented which result in a further increase in the use of grain in the EU-27's production of bioethanol. It is assumed that the total incorporation percentage of all types of biofuels remains unchanged and that bioethanol's share in the total use of biofuels also remains unchanged. The EU-27's bioethanol imports then decline from 18.7 million tonne grain equivalents to 5.7 million tonnes. Table S2 shows that although the grain supply has increased the extra use of grain in the production of bioethanol stabilises the grain price.

Table S2 **Effects of the withdrawal of more or less grain from the EU-27 market in times of a grain surplus and a grain deficit on the grain price**

Production change in the EU-27 relative to the baseline scenario (%)	Price change in the EU-27 relative to the baseline scenario (%)	
	without variation in the use of grain in the production of bioethanol	with variation in the use of grain in the production of bioethanol
-5	+7.0	0
5	-8.0	-0
10	-15.6	-4.5

Source: LEITAP.

However, when the grain yield per hectare is 10% higher in an alternative scenario and the total supply of grain in the EU-27 is also 10% higher than the standard in the 2020 baseline scenario then this will result in an extra supply of about 26 million tonnes of grain (10% of 260 million tonnes of grain). In this instance, the import of 18.7 million tonnes of grain equivalents will be insufficient to absorb the entire grain surplus and fully stabilise the grain price. However, the withdrawal of the surplus grain for the production of bioethanol does have a significant stabilising and price raising effect in comparison with the *non*-withdrawal of the surplus of grain from the market. Table S2 shows that in 2020 a grain surplus of 10% of the net production that is not withdrawn from the market for the production of bioethanol would result in a 15.6% fall in the grain price. If 18.7 million tonnes of the surplus of 26 millions of grain were withdrawn from the market then the fall in the grain price would be limited to 4.5%. Table S2 does not take account of the additional storage of grain or bioethanol.

A grain deficit would have largely the same effects as a grain surplus. This study examined the effect of a 5% lower grain yield per hectare, equivalent to a 13 million tonne decline in the net production of grain in the EU-27 as compared to the net production of grain in the 2020 baseline scenario. The market will initially respond to a grain deficit by increasing the grain price. A higher grain price will automatically result in a decrease in the grain used in the EU-27's production of bioethanol that attenuates a further increase in the grain price. Additional measures that result in the further reduction in the use of grain in the production of production of bioethanol will ultimately result in the full stabilisation of the grain price, even though the supply of grain has fallen (see Table S2). In the new situation, the use of grain in the production of bioethanol has declined from more than 29 million tonnes to 16 million tonnes, whilst the use of grain for food and feed has returned to the level in the 2020 baseline scenario.

A more stable grain price also results in more stable prices in other agricultural sectors. In addition, the stabilisation of the grain price by the variation of the use of grain in the EU-27's production of bioethanol has an effect on the market for bioethanol by-products (distiller's dried grains with solubles, abbreviated to DDGS in this report) and the EU-27's market for bioethanol. In the event of a grain surplus and an increase in the EU-27's production of bioethanol the DDGS price will decrease by an amount of between 4 and 10% depending on the size of the grain surplus and the quantity of grain withdrawn from the market for the production of bioethanol. This decline in the price will have a limited effect on the price of bioethanol, which will fall slightly. Conversely, the DDGS price will increase in the event of a grain deficit resulting in the reduced use of grain in the EU-27's production of bioethanol. However, the price of bioethanol will then fall slightly.

The first question examined in this study was whether the policy for the variation of the use of grain in the EU-27's production of bioethanol would achieve the desired effect, namely a more stable grain price in the EU-27. On the basis of the analysis, this question can largely be answered in the affirmative. The stability of the prices of other agricultural products would also increase, while the effects on the prices of bioethanol and bioethanol by-products would be limited.

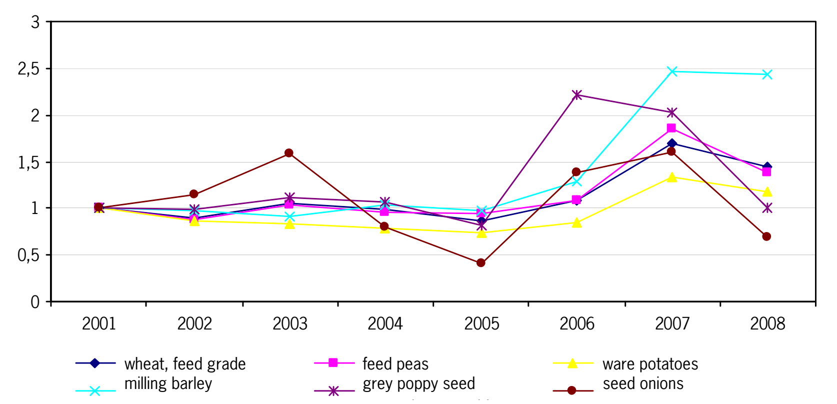
However, the scope of this study did not extend to a review of the technical feasibilities, the effect of the policy on the utilisation and availability of bioethanol production capacity, the optimum stable grain price level or the consequences of the policy for international trade. Neither did the study take account of the effects of speculation and stock management. However, these aspects do need to be taken into account when reviewing whether the aforementioned policy is both feasible and desirable. They also need to be taken into account when implementing the policy.

1 Introduction

1.1 Background

The arable farming sector, including the primary grain sector, is characterised by annual fluctuations in yields per hectare that are in part outside the producers' control. Consequently, in years with a high yield per hectare, relatively more grain and other arable products will be supplied to the market and additional sales will need to be made to avoid a surplus. This costs time and effort and, in view of the inelasticity of demand, the higher quantities will result in relatively large declines in the price of arable products. To date, the intervention system ensured that the grain price did not fall below a specific level. Since the markets for arable products are linked on both the supply side and the demand side this floor price for grain indirectly supports the price of other arable products. Figure 1.1 shows the mutual relationship between the prices of vegetable products. Supporting the grain price also has the additional effect of supporting the income of the producers of arable products.

Figure 1.1 **Movement in the prices of a selected number of arable products in the Netherlands in the period from 2001 to 2008. Index: 2001 = 1**



Source: BINternet, LEI.

Large movements in price, for example due to the alternation of good years with high yields per hectare and poor years with lower yields, result in the poor performance of the price mechanism relating to the determination of the optimum deployment of the scarce means of production. For example, companies with a long-term viability in normal conditions can nevertheless be confronted with short-term liquidity problems. In addition, large price fluctuations result in over-investments in times of high prices (due to the incorrect interpretation of price signals) and under-investments in times of low prices due to increased uncertainty. Consequently, price fluctuations result in extra transaction costs such as the costs incurred in resolving the aforementioned liquidity problems. They also impede the stable development of the production capacity required to meet the actual movements in demand. These disadvantages are not felt solely by grain producers and traders: the same imperfections also occur elsewhere in the chain. For this reason, the entire chain prefers more stable prices, since this provides for stable planning and avoids the loss of markets on the substitution of the product with other products (Keane and O'Connor, 2009). Price fluctuations also result in additional risks and repeated price negotiations with, for example, the retail sector.

1.2 Motivation

In an amendment to the EU's grain intervention system that comes into force in 2010 only a limited amount of 3 million tonnes of food-grade wheat will come into consideration for intervention at a price of €101.31 per tonne. Intervention for barley and maize will be abolished entirely. At lower prices the Commission can buy more grain via intervention tenders. The effect on the grain price depends on the time at which the Commission invites tenders. This continues the liberalisation of the grain market and will result in extremely large declines in prices and incomes. This, in view of the inelasticity of demand, will be particularly marked in years of good crops and high stocks.

The grain chain is of the opinion that this development and the resultant price volatility gives cause to the need for a new market instrument that is tailored to the times.

1.3 Problem

The problem is the price volatility of grain observed in recent years, a volatility that is detrimental to grain producers and grain traders. In addition, since the amendment of grain intervention system could result in the grain price falling below the current intervention price for a shorter or longer period of time the price volatility could increase further.

1.4 Objective

The European Union adopted its biofuel policy, what is referred to as the 'Biofuels Directive', in May 2003 (EU, 2003). This Directive provides for the obligation to incorporate biodiesel and bioethanol in fossil fuels used for road transport. This incorporation obligation will be introduced in phases. The EU-27's current biofuel policy is based on the obligatory incorporation of at least 10% biofuel, including bioethanol, in 2020. Bioethanol is produced from raw materials including grain and then, in particular, soft wheat and maize. This, to the extent that the incorporation obligation has an influence on the use of grain for bioethanol and the grain price, opens up opportunities for the use of the biofuel policy to influence the grain market.

The objective primary objective of this study was to obtain an insight into the feasibility of stabilising the grain market and cereal prices by varying the use of grain in the EU-27's production of bioethanol. The secondary objective of this study was to obtain an insight into the effects of the aforementioned stabilisation of the grain market on the markets for other agricultural products, bioethanol, by-products from bioethanol and cattle feed.

1.5 Assumptions and demarcation

The question formulated in the objective was quantified using the most recent version of the LEITAP model. LEITAP is an economic model of the international trade in a large number of products, including energy and agricultural products. A number of minor modifications were made to further improve the definition of bioethanol. The model calculations were carried out at EU-27 level.

Since the time horizon of the study is 2020 the first step was to use LEITAP to make a description of the prices and quantities in the relevant EU-27 markets in 2020 that took account of the incorporation obligation of at least 10% biofuel. One of the important assumptions in this study was that the obligation to incorporate at least 10% biofuel did not change in the alternative scenarios. Another important assumption was that bioethanol's share in the total use of biofuels is constant in the alternative scenarios as compared to the 2020 baseline scenario. If this assumption was not made then variations in grain prices would be passed on to prices in the EU-27's other agricultural sectors. With the aforementioned assumptions changes in the EU-27's production of bioethanol from grain result in changes in the imported quantity of bioethanol.

A further important assumption was that the various scenarios have no effect on the storage of grain or bioethanol. Consequently, the storage of grain and bioethanol is assumed to be constant.

The study did not examine the best approach to the implementation of the policy for the withdrawal of a greater or lesser quantity of grain from the market, i.e. the technical feasibility. Nor did the study examine the effect of the policy on the utilisation and availability of bioethanol production capacity or the consequences of the policy for international trade. Neither did the study take account of the effects of speculation and stock management. However, these aspects do need to be taken into account during the implementation of the aforementioned policy.

In addition, the study did not examine the effects of the new intervention system. The various scenarios that are explored in this study relate to a possible situation in 2020. This assumes that the grain price is no longer supported in the new intervention system. Consequently, this study did not include an interaction between the withdrawal of surplus grain for bioethanol production and the new intervention system.

1.6 Method

The study was carried out in a number of steps/phases:

Phase 1. Project preparation and project management

The study was prepared in a number of discussions that resulted in a plan of approach with the various scenarios to be explored.

Phase 2. Collection of data

The necessary data was collected by holding discussions with experts and studying the available literature and sources of data. This provided the answers to the following questions:

- the overall grain market (production, consumption, imports, exports, pricing);
- the overall bioethanol market (production, consumption, imports, exports, pricing);

Important sources of data were:

- Commodity Board for Arable Products (PA);
- European Bioethanol Fuel Association (eBIO) (www.ebio.org);
- European Commission (EC);
- United States Department of Agriculture (USDA).

Phase 3. Verification of the LEITAP basis data/development of the 2020 baseline scenario

The results from steps 1 and 2 were used to modify LEITAP to achieve the best possible reproduction of the available data with the model. The results yielded by LEITAP in the 2020 baseline scenario were then examined to determine whether they gave a realistic impression of the various markets in 2020, in particular the markets for grain, bioethanol and bioethanol by-products.

LEITAP's grain market makes a distinction between wheat, rice and other grain (including maize). LEITAP assumes that virtually all bioethanol is produced from wheat. LEITAP was modified for this project to include both wheat and maize as raw materials for bioethanol.

Phase 4. Defining and running alternative scenarios

In addition to the baseline scenario developed in steps 1 and 2, in which the results from LEITAP were harmonised with the available data about the various relevant markets, a number of alternative scenarios were also explored.

LEITAP determines the grain price within the model on the basis of supply and demand factors. The variation in the EU-27's use of grain in the production of bioethanol is one of the factors that can influence grain supply and demand. This was examined by formulating scenarios in which the grain price is relatively low and scenarios in which the grain price is relatively high. These were then used to review whether the variation in the use of grain in the production of bioethanol can influence the EU-27's grain price. The scenarios that were explored are shown in Table 1.1.

Table 1.1	**Het 2020-basisscenario en de alternatieve scenario's in 2020**				
		grain yield per hectare			
		reference	**high**	**low**	**very low**
grain price	reference	baseline scenario			
	low		scenario 1		
	high			scenario 2	
	very low				scenario 3

Scenario 1 assumes market developments that result in a relatively low grain price, for example a high yield per hectare and high production as compared to the reference period that result in a lower grain price. The grain price is supported by withdrawing part or all of the grain surplus from the market for the preparation of bioethanol. As indicated earlier, it is assumed that the EU-27's additional production of bioethanol results in lower bioethanol imports. The total availability of bioethanol remains constant. In LEITAP this substitution of imported bioethanol by EU-27 bioethanol is promoted by raising the import levy on bioethanol. This results in the same effect as, for example, an obligation to use an extra quantity of grain for the production of bioethanol.

Conversely, scenario 2 assumes market developments that result in a relatively high grain price, for example due to a very low yield per hectare that results in low production and a much higher grain price. In comparison with scenario 1 LEITAP now withdraws much less grain from the market for the EU-27's production of bioethanol. In LEITAP, this is promoted by reducing the import levies on bioethanol. The import of biofuels such as bioethanol now increases to maintain compliance with the obligation to incorporate biofuel in fossil fuels. This effect could also be achieved by lowering the mandatory quantity of grain to be used for the production of bioethanol.

Scenario 3 is comparable to scenario 1 except for the extremely high yield per hectare that results in a further decline in the grain price.

Phase 5. Sensitivity analyses

In the model used in this study, the feasibility of fully stabilising the grain price depends on factors including the size of the grain surplus/deficit in relation to the quantity of the EU-27's imports of bioethanol and the EU-27's production of bioethanol from grain, as well as on the demand price elasticity. The demand price elasticity indicates the degree to which the grain price changes on a specific change in the net production of grain. In view of the long time horizon of the study, to 2020, there is a great deal of uncertainty about the size of the net production of grain and the demand price elasticity of grain. For this reason, a sensitivity analysis was carried out to review the extent to which the feasibility of stabilising the grain market and grain price depends on the levels of the aforementioned variables.

Phase 6. Qualitative analysis and report
The report contains the results from the study of the sources and the quantitative analysis of the grain prices and prices of other products. In addition, a qualitative analysis was carried out of a number of elements, in particular of the potential income effects in a number of sectors including the primary grain sector and bioethanol sector.

1.7 Layout of the report

Chapter 2 reviews the grain market, including a preview of the years to 2020. Chapter 3 reviews the bioethanol market, including a preview of the years to 2020. Chapter 4 presents the results from the 2020 baseline scenario, the alternative policy scenarios and the sensitivity analyses. Chapter 5 contains a more qualitative review of the extent to which more stable prices result in more stable incomes in a number of selected sectors. Chapter 6 completes the report with a discussion and the conclusions from the study.

2 The grain market

2.1 Global production

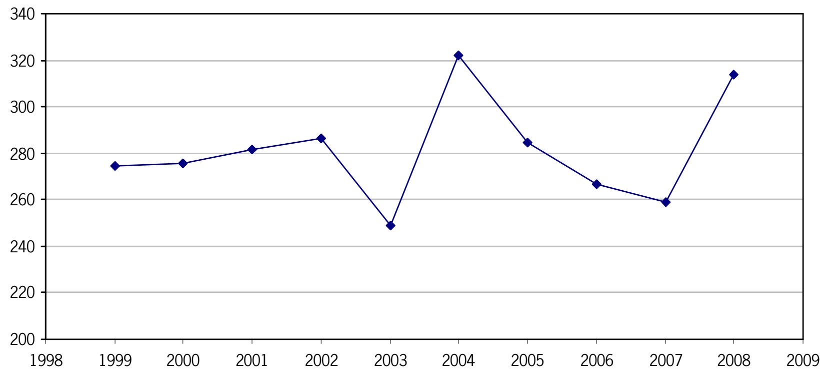
The developments in the global grain market in 2008 differed greatly from the forecasts (Berkhout and Van Bruchem, 2009). The exceptional situation in 2007, with low stocks and extremely high prices, was followed by a sharp fall in prices in 2008. In 2008, the global production of grain increased by more than 7% (Table 2.1). The 11% increase in the production of wheat was most striking, as well as the record harvests of feed grains. This growth in production was due to the expansion of the area under cultivation, in response to the high prices in 2007, in combination with the excellent weather and the extra investments in existing crops (crop care, fertilisation and sowing seed). The production from 2008 and the forecast production from 2009 (the definitive figures are not yet available) will be sufficient to meet the demand for grain. However, in the shorter term the lower prices in combination with the uncertainty caused by the global economic crisis will result in lower production. Initial estimates from the FAO indicate a more than 3% decline in grain production in 2009, primarily due to the reduced area of land allocated to the cultivation of grain (FAO, 2009). These lower prices, in combination with the persistent high cost price, will result in a switch to other crops. An increasing demand for grain and the declining area of land used to cultivate grain could result in future supplies that cannot fully meet demand in some years.

Table 2.1 Global production of grain (million tonnes), 2006-2009

	2006	2007	2008	2009 a)
Grain, of which:	2,011	2,132	2,289	2,217
- wheat	597	610	689	655
- feed grain	985	1,081	1,142	1,100
- rice	439	441	459	462

a) Provisional.
Source: FAO (2009).

Figure 2.1	Grain production in the EU-27 (million tonnes)



Source: Eurostat, different years.

2.2 Availability and consumption of grain in the EU-27

Figure 2.1 shows the movement in the EU-27's grain production in the past ten years. Production fluctuated between 250 and 300 million tonnes in the past ten years, with peaks in 2004 and 2008, when 320 and 313 million tonnes of grain respectively were produced.

Table 2.2 shows the balance between the availability and consumption of grain in the EU-27 in three seasons. The EU's production (the harvest) was relatively low in the 2007/2008 season, over 256 million tonnes, whilst production in the 2008/2009 season was the highest in the EU-27 in the past ten years bar one (compare with Figure 2.1). Production in the 2009/2010 season is also forecast to be above average. Table 2.2 also shows that the EU-27's imports of grain increase to meet the region's needs in years in which harvests are lower, such as in the 2007/2008 season. Grain imports are primarily comprised of qualities that are not produced by the EU-27 (such as hard wheat) and maize that may be imported by Spain and Portugal at reduced import levies. WTO commitments could also result in imports of grain at lower import levies.

Table 2.2	**Availability and consumption (balance) of grain in the EU (EU-27) (million tonnes)**		
	2007/2008	**2008/2009**	**2009/2010 a)**
Available stock	50.5	49.4	63.2
Intervention stock	2.6	0	1.6
Total stock	53.1	49.4	64.8
Harvest	256.4	312.8	290.2
Imports	27.7	11.7	9.1
Available quantity	337.2	373.9	364.1
Consumption	270	274.3	275.2
of which:			
- human consumption	63.3	63.6	64.1
- seed	11.8	11.3	11.4
- industry	21.2	21.3	21.3
- bioethanol	2	6.2	7.5
of which:			
- wheat	1.1	2.8	4.1
- barley	0.5	1.0	0.4
- maize	0.3	1.9	2.5
- rye	0.1	0.5	0.5
- animal feed	171	171	170
- other	0.7	0.9	0.9
Exports	17.8	34.8	26.8
Stock	49.4	64.8	62.1
of which:			
- available stock	47.5	63.2	55.4
- intervention stock	0	1.6	6.7
Total stock	337.3	371.9	364.6

a) Forecast, as at 22-2-2010.
Source: Commodity Board for Arable Products.

Some years ago, the EU specified a maximum for the import of low and average quality grain and barley at a reduced import levy. This maximum is about 2.4 million tonnes (Klein, 2010). The import levy below 2.4 million tonnes is €12 per tonne. Above this level the levy is €95 per tonne. In addition, Spain and Portugal are entitled to import 2 million tonnes of maize and 0.3 million tonnes of sorghum (Spain) and 0.5 million tonnes of maize (Portugal) at a reduced import levy.

About half of the available grain is allocated to the production of animal feed and a not-insubstantial proportion (20%) to human consumption (Table 2.2). In addition, Table 2.2 shows that grain used for the production of bioethanol has increased from 0.6% of the available quantity of grain in 2007/2008 to more than 2% in 2009/2010.

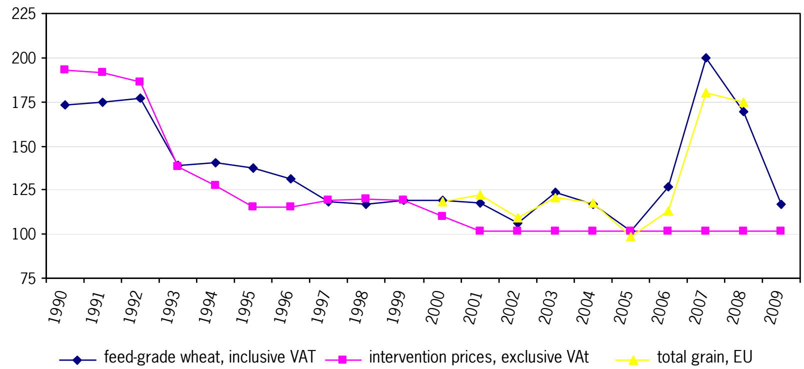
About 6% of the total available quantity of grain was exported in the 2007/2008 season: this increased to 9% in the 2008/2009 season when the EU production was much higher. Exports are expected to amount to about 7% in the 2009/2010 season, a fall due to the lower grain prices quoted on the international market that greatly complicate exports. In the 2008/2009 season, wheat accounted for more than 50% of exports and barley for more than 33%: in the 2009/2010 season, the figures will be almost 84% and a little over 7% respectively. The majority of the exported wheat is feed grade wheat since there is a shortage of milling-grade wheat in the European Union.

Stocks increased sharply in the 2008/2009 season, from 49.4 million tonnes in 2007/2008 to more than 64.8 million tonnes in 2008/2009. The intervention stock increased substantially in the 2009/2010 season, to 6.7 million tonnes.

2.3 Grain prices and market intervention

Figure 2.2 shows the movements in the average price of feed grade wheat in the Netherlands over the course of the years. Figure 2.2 also provides insight into the associated intervention price and average price of wheat in the EU-27 (for a more limited number of years). Figure 2.2 shows that both the price of feed grade wheat in the Netherlands and the average price in the EU fluctuate around the grain intervention price. 2007 in particular and, to a slightly lesser extent, 2008 were exceptions. The available stocks in these years were relatively low.

Figure 2.2	Average price of feed grade wheat in the Netherlands, average EU grain price and soft wheat intervention prices in the EU, 1990-2009, in euros per tonne



Source: Agricultural and horticultural figures, different years; Eurostat, different years.

The grain price fell back sharply in 2009 to the intervention price level. The intervention price is currently €101.31 per tonne. At present (February 2010) unlimited quantities of milling-grade wheat and brewing-grade barley can be offered for intervention. The intervention system for grain will be amended on 1 July 2010 whereby the intervention will be limited to a maximum of 3 million tonnes of milling-grade wheat, at a maximum intervention price of €101.31 per tonne. Pursuant to the new system, at low grain prices the Commission will be able to buy quantities of other types of grain and milling-grade wheat above 3 million tonnes via intervention tenders with bids for wheat, barley, maize and rye. The Commission currently buys grain in the country in which it is produced. The Commission wishes to enable growers and the trade to submit tenders in other member states since the transport costs will then be lower for the party submitting the offer and the tender price for the EU will be lower than the current intervention price. Consequently, the price for the producer will ultimately also be much lower.

The ultimate difference between the intervention price and the lower tender price extent is not currently clear, since this will depend on the time at which the Commission withdraws grain from the market using the new intervention system: should the Commission decide to make use of the system only when the price quoted for wheat, barley, maize and rye falls, for example to €65.00

per tonne in Poland, Hungary and Austria, then it will be evident that European grain prices can sink to much lower levels. If the Commission decides to make intervention purchases using the intervention system at a much earlier level then the tender price could lie closer to the current intervention price (€101.31 per tonne).

The current grain intervention stock of more than 5 million tonnes is also of importance to the short-term grain price. Should the grain price increase to a level of, for example, €140 per tonne, then the Commission will decide to sell this grain on the internal market. These sales will influence the further increase of grain quotations.

Export refunds

At the beginning of the 1990s, the intervention price for soft wheat was still about €185 per tonne (Figure 2.2). When harvests were good, a large quantity of grain was offered for intervention at the aforementioned price: when the intervention centres were full, the Commission proceeded to the award of export refunds in a tender procedure. Traders in the EU member states were then able to submit bids, for example for the export of 20,000 tonnes of wheat at a refund of €45 per tonne. The Commission collected all bids from the member states and then, during a Grain Management Committee, drew a line whereby, for example, all bids to a maximum of €48 per tonne were accepted (Klein, 2010).

The substantial reduction of the intervention price has obviated the need for a refund since EU prices are now often equal to the prices quoted on the international market. However, the copious global grain harvests in recent years in combination with the weak dollar (which a few months ago was still USD1.50 for €1) resulted in the fall of the barley quotation in Ukraine to USD130 per tonne (about €87 per tonne), a level at which barley exports from the EU were no longer feasible without a refund. A number of member states requested the Commission to set a barley intervention price. However, the then Commissioner, Ms Fischler Boell, refused the request. As a result, the barley intervention stock currently amounts to about 5 million tonnes.

With the weaker euro, the EU currently offers the cheapest barley to the international market. Consequently no export refund is then necessary to export barley to the international market. In view of the price differences in Europe, the French Minister of Agriculture recently asked for a refund for barley. However, this request was refused.

During the WTO negotiations the previous Commission offered to terminate the award of refunds in 2013. However, this offer dates from 2006, when a crisis was still in the future and all specialists still assumed wheat prices of at least €150.00 per tonne.

It is still unclear whether the new Commission will implement new measures such as undoing the intervention measures that were implemented in 2008 (many member states are requesting the Commission to do so). However, if the Commission does not undo these measures then it is highly likely that European grain will be available in the international market at the lowest price. No grain will then be bought for intervention and export refunds will be superfluous. The export refund procedures (export tenders) are still in place, so there is an opportunity to make use of these for grain in the same manner as for butter and milk powder a few months ago.

2.4 Long-term movements in the grain price

The high price of grain in 2007 and the favourable weather resulted in a record harvest in 2008. The large harvest provided for the replenishment of stocks. With average harvests, this would calm down the markets from 2009, with a stable but lower price. The high prices resulted in a great increase in production in 2007 and 2008. It is now expected that the lower price level will result in the worldwide use of a smaller area of land and other means of production for the cultivation of grain.

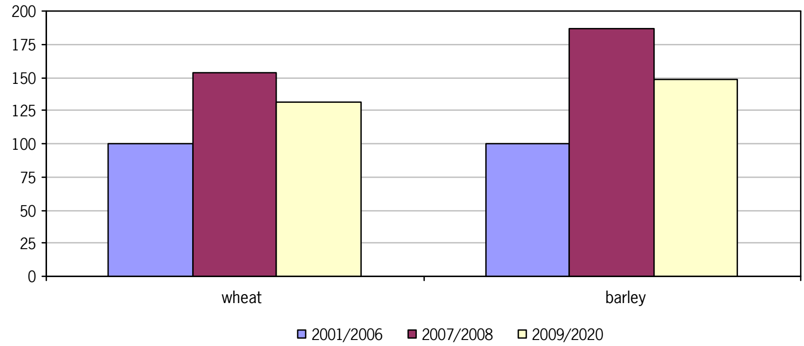
On the demand side the per capita human consumption of grain has been declining for many years. This will also have a detrimental effect on future grain prices. The demand for grain for cattle feed purposes will continue to develop, although to a limited extent due to the current economic crisis and the resultant limited development of meat consumption. In addition, a possible WTO agreement would result in a large decline in import levies on meat. This will result in an increase in imports of meat from Brazil, Argentina and the USA. Europe will then need less grain for cattle feed purposes, which will be detrimental to the European grain price. In addition, improvements to cattle feed will enhance feed conversion, as a result of which less grain will be required for the production of meat (Klein, 2010).

In contrast with the aforementioned limited developments on the demand side, demand for grain for the production of bioethanol will increase due to the obligation to incorporate biofuel in fossil fuels in the EU and the USA. Although the precise area of land used for the production of biofuels is not known (Berkhout and Van Bruchem, 2009), the total amounts to about 17 billion hectare in the USA, EU and Brazil (Banse, 2009). When the shares of these countries/region in the world's production are taken into account then a rough estimate results in the conclusion that between 20 and 25 million hectares are used to cultivate the raw materials used to make biofuels, equivalent to about 1.5% of the world's total area of arable land. This low percentage could give cause to the impression that biofuel production has a minor effect on prices in the international market. However, a number of studies indicate that the price effects are not insignificant. For example, Banse et al. (2008) conclude that the EU biofuel policy until 2020 alone will result in an increase in the price of grain and oilseeds on the international market of 6 and 8% respectively. Calculations made by the OECD indicate that the support measures for biofuels will result in grain prices that are about 5% higher and in oilseed prices that are about 3% higher than the prices would have been in the absence of these measures (OECD, 2008).

It is uncertain whether this forecasted increase in the demand for grain for the production of bioethanol and the associated aforementioned price effects will actually materialise. This uncertainty is due to two factors: firstly, the speed at which the second generation of biofuels can be brought onto the market at competitive prices and, secondly, the uncertainty about the continuity of biofuel policy. This latter is due to the possibility that biofuel policy could be amended for food security, environmental and general economic reasons.

Silvis et al. (2009) review the longer-term movements in grain prices (Figure 2.3). On the basis of the assumptions made for the reference scenario, most of which are in agreement with the assumptions reviewed earlier in this report, the average wheat and barley prices will be higher in the period from 2009 to 2020 than in the period from 2001 to 2006. However, the prices are significantly lower than the high levels of 2007 and 2008 that were caused by the shortages in the international market.

Figure 2.3	Nominal average price movement of wheat and barley in the various periods to 2020. Index: average price in the 2001/2006 period = 100



Source: Silvis et al. (2009).

The findings of Silvis et al. (2009) are confirmed by studies carried out by the OECD (2009) and USDA (2010). These two studies forecast, in agreement with the long-term trend, that once the stocks have been replenished the real price of grain will fall.

However, brief periods of strong price fluctuations around this stable trend are possible. Within the EU, these will be caused by the further liberalisation of grain market policy. However, EU production will exceed consumption in the coming years and the annual export surplus will amount to approximately 15 million tonnes (Berkhout and Van Bruchem, 2009). The current high intervention stocks resulting from the high production in 2008 are expected to have depleted within three years and will no longer be available to attenuate price increases.

In addition, it is expected that the international market for the various agricultural crops will become more intertwined with the energy market, due both to the effect of the energy price on the price and cost of fertilisers and the production and transport of agricultural crops and to the increased use of biofuels for the generation of energy. Moreover, with the globalisation of the world's economy national economies are increasingly being exposed to jolts at a global level and their concomitant consequences for the consumption of agricultural products, et cetera. The climate change and resultant fluctuations in the weather conditions will result in an increased variation in harvests that will in turn result in more unstable production and trade flows, as well as more unstable prices of agricultural products traded in the international market (OECD, 2009).

2.5 Conclusions

In the somewhat longer term and with the new intervention system, a good harvest could result in a sharp fall in the grain price. However, this is in part dependent on the time at which the Commission proceeds to intervention purchases. In addition, a lower floor price will create more room for price movements above that price. Consequently, price volatility will increase in the new system. In addition, if production falls back to an average level in the coming years then the stocks will contract rapidly. It is generally believed that changes in stocks make a large contribution to grain price volatility. Price fluctuations of the nature of those in 2007 and 2008 will become more frequent than in the past.

The EU-27's share in the global production of grain amounted to almost 14% in the 2008/2009 season. The share in the 2007/2008 season was almost 12%. These shares in part determine the influence the EU-27 can exert on prices in the international market. Exports of grain from the EU to the international market attenuate changes in the EU's grain price.

3 The bioethanol market

3.1 Introduction

Biofuels are liquid or gaseous fuels for transport that are produced from biomass, a biodegradable fraction of products, waste and residues from agriculture (including vegetable and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste.

A number of products are classified as biofuels, such as bioethanol and biodiesel. Bioethanol is suitable for use with petrol engine vehicles and biodiesel for use with diesel engine vehicles.

Sugar is needed to produce bioethanol by fermentation. Since the majority of vegetable matter is comprised of sugar every type of vegetable matter is, in principle, suitable for the production of bioethanol. In practice, the choice depends on the plants that grow best in the prevailing local conditions (climate, landscape and type of soil, et cetera). In addition, the sugar concentration and the ease with which the vegetable matter can be converted into ethanol also play a role.

3.2 Global production of bioethanol

Bioethanol is the type of biofuel used most all over the world. The total production of bioethanol amounted to more than 77 billion litres in 2008 (Table 3.1). The USA is currently the largest producer of bioethanol, followed by Brazil. The USA produced 35 billion litres of bioethanol in 2008 (Table 3.1) while Brazil produced about 25 million litres in the same year. The USA overtook Brazil, until then the world's largest producer of bioethanol, in 2006.

Sugar beet is the primary raw material used to produce bioethanol in Brazil, maize in the USA.

Table 3.1	Global production of ethanol, 2000-2008 (million litres) a)			
	2000	**2006**	**2007**	**2008**
European Union	2,459	3,415	3,600	4,523
Rest of Europe	1,172	1,239	1,257	1,334
Africa	485	631	677	715
North and Central America	8,307	20,668	27,227	35,397
South America	11,128	18,597	23,393	27,028
Asia	5,836	6,622	7,771	7,828
Australia	177	172	202	271
Total	29,564	51,344	64,127	77,096

a) Not destined solely for biofuel.
Source: Commodity Board for Arable Products (2010).

3.3. Bioethanol in the EU

3.3.1 Introduction

The transport sector accounts for more than 30% of the EU's end consumption of energy and this share continues to grow. This trend will probably increase further, together with a proportional increase in carbon dioxide emissions. In 1998 the European Parliament called for an increase in the market share of biofuels to 2% over 5 years. This was to be achieved by the implementation of a package of measures including tax exemption, financial assistance for the processing industry and the establishment of a compulsory rate of biofuels for oil companies. The optimum method for increasing the share of biofuels in the national and Community markets depends on the availability of resources and raw materials, on national and Community policies to promote biofuels and on tax arrangements, and on the appropriate involvement of all stakeholders/parties.

The European Commission ultimately set the target of 5.75% substitution of conventional fuels by renewable fuels in the road transport sector by the year 2010. The substitution will need to be a minimum of 10% by 2020.

To this end, Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport on 8 May 2003. The Directive aims at promoting the use of biofuels or other renewable fuels (sustainably produced hydrogen) by road traffic (consequently, air transport and shipping do not fall under the Directive) with a view to contributing to objectives such as meeting climate change commitments, environmentally friendly security of supply and promoting renewable energy sources. A further benefit of the introduction of biofuels is the reduction of Europe's dependency on oil imports. In addition, the agricultural sector will also benefit from the introduction of biofuels.

However, the proportion of bioethanol that can incorporate in fossil fuel is not unlimited. At present, most EU member states are limited to an about 10% incorporation of bioethanol in fossil fuel without problems for the vehicle. The vehicle's engine needs to be modified at higher percentages. These costs can be appreciable, in particular for petrol engine vehicles. Consequently, the 10% incorporation target for 2020 was not selected entirely at random. However, the limitations imposed on incorporation due to the limited ability of engines to absorb the effects of biofuels may have been lessened by 2020. Bioethanol is now being added to fuel used by diesel engine vehicles.

The obligation to incorporate 5.75% biofuel by 2010 is a target. The majority of the EU member states have adjusted the 2010 target downwards, in part due to the economic crisis and the possible relationship between the high grain prices and the incorporation obligation. Table 3.2 lists the objectives between 2008 and 2010 in the various EU member states. Table 3.2 shows how the target can vary between member states.

The actual incorporation percentages differ from the targets. In 2006 the average incorporation percentage in the EU was 1.97%, a figure which had increased to 3.3% in 2009. Analysts/specialists expect a maximum of 4% in the entire EU in 2010. The approximately 7.5 million tonnes of grain used for the production of bioethanol in the 2009/2010 season (table 2.2) contributed to this percentage.

Table 3.2	**Targets for the incorporation of biofuel in each EU member state (% of total fuel consumption)**		
	2008	**2009**	**2010**
Austria	5.75	5.75	5.75
Belgium	-	-	5.75
Bulgaria	2.00	3.50	5.75
Cyprus	N.a.	N.a.	N.a.
Czech Republic	2.45	3.43	5.75
Denmark	-	-	5.75
Estonia	-	-	5.75
Finland	2.00	4.00	5.75
France	5.75	6.25	7.00
Germany	- (6.25)	5.25 a) (6.75)	6.25 a)
Greece	4.00 (5.00)	2.50 a) (5.75)	3.00 a)
Hungary	-	4.50 b)	5.75
Ireland	2.24	-	3.20
Italy	2.00	3.00	5.75
Latvia	4.25	5.00	5.75
Lithuania	-	-	5.75
Luxembourg	-	-	5.75
Malta	N.a.	N.a.	N.a.
The Netherlands	-	- (5.75)	4.00 a)
Poland	-	4.60	5.75
Portugal	5.75	5.75	5.75
Romania	3.00 c)	4.00	5.75
Slovakia	4.00	4.90	5.75
Slovenia	3.00	4.00	5.00
Spain	1.90	3.40	5.83
Sweden	-	-	5.75
UK	2.50 b) (3.75)	3.00 a) b) (5.00)	3.50 a) b)
EU	-	-	5.75

a) Amended, previous incorporation percentage between brackets; b) Based on volume; c) Solely biodiesel.
N.a. = Not available; - = No target.
Source: USDA (2008).

3.3.2 Production and consumption of bioethanol in the EU

By far the most bioethanol produced in the EU is made from raw materials including grain, sugar and wine (alcohol). However, no unequivocal figures for the total amount of raw materials used to produce bioethanol are available. Some estimates indicate that 53% of all bioethanol is produced from grain, 27% from sugar and 20% from other raw materials including wine (alcohol) and low-grade agricultural residues (Commodity Board for Arable Products (PA), 2010). However, other sources refer to 70% bioethanol produced from grain (*Vlaams Infocentrum Land en Tuinbouw* (VILT), 2009). It is clear that these percentages can vary from year to year, depending on the circumstances, pricing of the raw materials and political decisions.

The EU's production of bioethanol increased by almost 60% to 2.8 billion litres in 2008 (Table 3.3). France became the largest producer of bioethanol in the EU in 2007, when the country overtook Germany and Spain. Seventeen of the 27 member states were producing bioethanol in 2008. Finland, that did not produce any bioethanol in 2006 and 2007, started production again in 2008. Belgium began to produce bioethanol in 2008. Precise information about the quantities is not yet available. More details about the Dutch biofuel policy and bioethanol production in the Netherlands are included in Appendix 1.

Table 3.3 also shows that the EU imported about 1.1 billion litres of bioethanol for transport purposes in 2008. The increase in the incorporation obligation is expected to result in an increase in both the EU's production capacity and imports. The EU's bioethanol production capacity will be expanded greatly in 2009, namely by 2.1 billion litres (Appendix 2). However, in view of the lack of clarity about the political policy to be conducted (no food for bioenergy, et cetera) investors are too uncertain to make further investments in bioethanol production plants.

In conclusion, Table 3.3 shows that the EU's bioethanol exports are negligible.

Table 3.3	Production, imports, exports and consumption of bioethanol in the EU, 2006-2008 (in million litres)		
	2006	**2007**	**2008**
France	293	539	1,000
Germany	431	394	568
Spain	402	348	317
Poland	120	155	200
Hungary	34	30	150
Slovakia	0	30	94
Austria	0	15	89
Sweden	140	120	78
Czech Republic	15	33	76
UK	0	20	75
Italy	128	60	60
Finland	0	0	50
Lithuania	18	20	20
Latvia	12	18	20
Ireland	0	7	10
The Netherlands	15	14	9
Belgium	0	0	N.a.
Total EU-27 production	1,565	1,803	2,816
Imports a)	230	1,000	1,105
Exports	38	44	51
EU-27 consumption	1,757	1,760	3,870

a) For transport.
Source: Biofuels Platform (2009); USDA (2009).

3.4 By products

The production of bioethanol from grain and sugar beet yields a substantial quantity of protein-rich by-products for the cattle feed industry. The starch is extracted from the grain during the bioethanol production process. The residue is comprised of a protein-rich by-product (DDGS, Distiller's Dried Grains with Solubles) that is sold to the cattle feed market. This product is extremely popular and is used to replace soya in cattle feed.

Table 3.4 gives an estimate of the EU-27's production of DDGS in 2008. These figures are based on the data for the EU's imports and total consumption of bioethanol enclosed in Table 3.3. In addition, it is assumed that 71% of the bioethanol produced in 2008 was made from grain and that 2.58 tonnes of grain yields:

- 1,000 litres of bioethanol;
- 0.96 tonnes of DDGS.

Table 3.4 shows that on the basis of the aforementioned assumptions the daily production of DDGS amounts to about 1.9 million tonnes DDGS. This, with a conversion factor of 1.33, replaces about 1.4 million tonnes of soya oil cake. This is a fraction of the imports of soya, which are estimated to amount to about 32 million tonnes.

Table 3.4 EU's demand for bioethanol, use of grain in the production of bioethanol and production of cattle feed by-product (DDGS) in 2008

	2008
EU's estimated demand for bioethanol (million litres)	3,870
Of which imports (%)	29
EU's bioethanol production (million litres)	2,765
Of which produced from grain (%)	71
bioethanol from grain (million litres)	1,963
EU's use of grain in bioethanol production (thousand tonnes)	5,070
DDGS (thousand tonnes)	1,886

Source: EBIO, researchers' calculations.

A large quantity of DDGS is available in the USA. However, this originates from GMO grain and cannot be used in Europe.

The quality of the cattle feed by-product obtained from the production of bioethanol from grain varies with the type of grain: for example, the by-product obtained from maize is slightly better than with wheat. The quality of the by-product obtained from barley is unknown. Rye does not yield a by-product, which is one of the reasons why this type of grain is not of interest as a raw material for bioethanol. For example, the former DDR used rye to produce bioethanol since the grain was of low value. However, the bioethanol plants were shut down when the rye price increased.

3.5 Prices of bioethanol and import duties in the EU

The average world reference ethanol price was USD48 per hectolitre (more than €32.5) in 2008 (OECD, 2009). The price had fallen by about 20% by February 2009, although in 2010 the world reference price appeared to be returning to the level of 2008 (USDA, 2010). At a world level the price of bioethanol is primarily related to the sugar price. Forecasts indicate that the bioethanol price will increase gradually (OECD, 2009). This is in part due to the increasing consumption resulting from the increased incorporation obligation and to the expectations that the potential for growth of Brazilian production and exports is limited.

The price of bioethanol in the EU is largely determined by the price of bioethanol on the international market plus the import duty. The EU's import duty on non-denatured bioethanol is €19.2 per hectolitre. Consequently, the producer's price of bioethanol suitable for use as biofuel in the EU is significantly higher than the average world reference price.

3.6 Cost price of bioethanol and investment costs

The production costs and prices of bioethanol can vary greatly between regions due to differences in the cost of the raw materials resulting from variations in the productivity of the region's agriculture, in the cost of land and labour, in the production capacity of the bioethanol plants, in the conversion technology used by the plants and in government policy.

Brazil is the producer with the lowest costs, due to the low input costs and relatively large and efficient plants. In addition, the Brazilian plants can switch from the production of sugar to the production of bioethanol fairly easily when the relative price ratios give cause for them to do so.

The extent to which the plants can utilise their production capacity is an important factor in determining the return times of the investment costs. Most of the EU's bioethanol production plants are based on the use of one type of raw material. In principle, the sugar industry's bioethanol plants can process both sugar (slurry) and grain. These plants process sugar beet during the season and grain outside the season. However, only a couple of plants possess this flexibility: this is not the general rule. In view of the sugar beet regulation, the sole sugar beet available for the production of bioethanol is the sugar beet cultivated outside the quota.

The European bioethanol production costs based on the use of grain are considerably higher than in Brazil. The European production costs vary between about €42 per hl to more than €62 per hectolitre (IEA, 2004). An investment of about €1 is required to produce 1 litre of bioethanol (Vierhout, 2010). Consequently, the investment costs amount to about 20% of the production costs. The cost of the raw materials accounts for sixty per cent of the bioethanol production costs, although more than half of this cost is compensated by the revenue from the by-product. The operating costs amount to about 50% of the production costs, exclusive of the revenue from the by-product.

The cost price of bioethanol is much higher than the cost of fossil fuels. An increase in the oil price or a decline in the exchange rate of the euro against the US dollar can improve the competitive position of biofuels relative to crude oil. However, recent developments have demonstrated that even the fall in the price of the raw materials used to produce biofuels that has resulted in a sharp decline in the cost price has been insufficient to enable biofuels to compete with fossil fuels. This is because the price of crude oil has fallen even further. The government measures imposing the obligation to use biofuel are expected to continue to be the main driving force behind the market for bioethanol and biodiesel.

When giving consideration to government policy it is important to note that there has been a great deal of social and political debate on the desirability of the use of biofuel in road transport. The benefits offered by biofuel were mentioned at the beginning of this chapter. One of the disadvantages of biofuel that is often cited is the effect on greenhouse gas emissions, which are reduced only very slightly and may even increase when account is taken of all the - often indirect - factors. Moreover, biofuel can also compete with food and, consequently, increase prices. In conclusion, nature areas can be put in jeopardy by the increased cultivation of biofuel crops (CBS, 2009). These sustainability criteria are currently being interpreted in terms of certification schemes that can be used to test biomass destined for the energy markets. One example of these certification schemes is the NTA 8081, which is based on the Cramer criteria for the sustainability of biomass.

3.7 Conclusions

The EU-27's production and consumption of bioethanol have increased greatly in recent years, in particular due to the government measures imposing the incorporation of biofuel in road transport fuel. However, the actual incorporation percentages differ from the targets. In 2006 the average incorporation percentage in the EU was 1.97%, a figure which had increased to 3.3% in 2009. Analysts/specialists expect a maximum of 4% in the entire EU in 2010.

The EU-27 used 6.2 million tonnes of grain to produce bioethanol in the 2008/2009 season. The EU-27 imported 1.1 billion litres of bioethanol in 2008. In view of the actual incorporation percentage of biofuels in the entire EU-27 in 2008 - between 2 and 3% - both the use of grain in the production of bioethanol and imports of bioethanol will increase greatly in the future, since the incorporation obligation will increase to at least 10% in 2020. This will also result in an increase in the production of distiller's dried grains with solubles (DDGS), a protein-rich cattle feed ingredient that can replace imports of protein-rich soya oil cake.

4 Scenarios and sensitivity analyses

The price effects of variations in the use of grain in the EU-27's production of bioethanol were quantified using the latest version of the LEITAP model, a model of the international trade in a large number of products, including energy and agricultural products (Van Meijl et al., 2006). LEITAP is derived from the Global Trade Analysis Project (GTAP) model (Hertel and Tsigas, 1997), a model that is often used in studies of pricing and international trade.

4.1 The 2020 baseline scenario

Table 4.1 shows the grain balance sheet for the past three seasons. Table 4.1 also shows the grain balance sheet in the 2020 baseline scenario on the basis of calculations using LEITAP. The net production of grain is estimated at about 260 million tonnes in 2020, lower than production in recent years due to the decline in the area of agricultural land used to cultivate grain in 2020 caused by the EU-27's decreased demand for grain. The 2020 baseline scenario assumes a further decline in human consumption of grain. The amount of grain required for animal feed also declines. The grain export balance remains roughly in equilibrium. Pursuant to the 2020 baseline scenario, the net grain export amounts to 3 million tonnes. In view of the great uncertainties the sensitivity analysis reviewed in Section 4.3 also extends to scenarios with a higher net grain production. The 2020 baseline scenario assumes a nominal grain price of €140 per tonne.

Table 4.1	Net production and consumption of grain in the EU-27 in various seasons and in the 2020 baseline scenario (in million tonnes)			
	2007/2008	2008/2009	2009/2010	2020
Net production a)	245	302	279	260
Consumption	245	302	279	260
of which:				
- human consumption	63.3	63.6	64.1	60
- industry	21.2	21.3	21.3	16
- bioethanol	2	6.2	7.5	29
- animal feed	171	171	170	152
Net export b)	-10	23	18	3
Movement in stock + other consumption	-3	16	-2	0

a) Harvest less seed; b) Export less import.
Source: Commodity Board for Arable Products. The results for 2020 are based on LEITAP calculations.

This study examined the feasibility of stabilising prices in the grain market by varying the use of grain in the EU-27's production of bioethanol. This is based on the assumption that the incorporation obligation of all types of biofuel remains unchanged at a total minimum of 10%. In addition, it is assumed that bioethanol's share in the use of biofuel remains constant. Pursuant to these assumptions in the various scenarios for EU-27's use of grain in the production of bioethanol variations in the amount of grain used will ultimately result in variations in bioethanol imports. In making the aforementioned assumptions the EU-27's imports of bioethanol and quantity of grain used for the production of bioethanol become communicating vessels in which the level in one vessel rises and the level in the other falls depending on the situation on the European grain market. Table 4.1 shows that pursuant to the 2020 baseline scenario 29 million tonnes of grain are used for the production of bioethanol.

The EU-27's demand for bioethanol in the 2020 baseline scenario is estimated to amount to 25 billion litres (Table 4.2). This estimate is made by the researchers on the basis of data such as that from the European Commission (2007), Vierhout (2010) and Banse and Grethe (2008). The assumptions about the total demand for biofuel and the share of bioethanol and biodiesel in the total use of biofuel play an important role in this estimate. The 2020 baseline scenario indicates a great increase in the EU-27's total demand for bioethanol as compared to 2008, namely by a factor of 6.5.

The 2020 baseline scenario retains the proportion of imported bioethanol at 29% of the total use, the same percentage as in 2008. In the 2020 baseline scenario the EU-27's absolute imports of bioethanol increase greatly from about 1.1 billion litres in 2008 to 7.25 billion litres in 2020. When expressed in grain equivalents the bioethanol imports amount to a maximum of 18.7 million tonnes of grain. The continuation of this study also uses 'import buffer' instead of 'imported quantity'.

Table 4.2 The EU-27's demand for bioethanol, import of bioethanol and import of bioethanol in grain equivalents in 2008 and in the 2020 baseline scenario

	2008	2020	Index (2008=1)
EU demand for bioethanol (billion litres)	3.87	25.0	6.5
of which imports (%)	29	29	
EU bioethanol imports (billion litres)	1.1	7.25	6.5
EU bioethanol imports in grain equivalents (million tonnes)	2.8	18.7	6.7

Source: Researchers' calculations based on data from various sources.

In the 2020 baseline scenario the EU-27's production of DDGS increases from about 1.9 million tonnes in 2008 to about 10.9 million tonnes in 2020. On the basis of the conversion factor of 1.33 this replaces about 8.2 million tonnes of soya oil cake, about 25% of the quantity of soya imported in 2008.

4.2 Effects of the alternative scenarios

The results obtained from the 2020 baseline scenario were supplemented with figures from the exploration of four alternative scenarios (Table 4.3). The precondition attached to all these scenarios was that the incorporation obligation of all types of biofuel to a total minimum of 10% was not impaired. In addition, bioethanol's share in the use of biofuel was assumed to remain constant. In conclusion, no account was taken of the extra storage of grain or biofuel.

Three scenarios relate to a change in the EU-27's grain yield per hectare. One scenario relates to a global change in the grain yield per hectare. The changes in the yield per hectare are 5% higher, 10% higher and 5% lower. The figures of 5 and 10% have been chosen since they are equal to one and two standard deviations for the grain production as compared to the growth trend. Consequently, there is a 5% probability that production will differ by more than 10% from the 'normal' production as assumed in the 2020 baseline scenario and an about 33% probability that the production will differ by more than 5%. Self-evidently, factors other than the variation in production also play a role in the price movements. For example, demand played a dominant role in 2007, when production fell short. The effects of the 4 scenarios for the European grain price are shown in Table 4.3.

Table 4.3 **Price effects of four alternative scenarios for grain in the EU**

	Production change relative to baseline scenario (%)	Price change in the EU relative to baseline scenario (%)		Price-raising or price-lowering effect in percentage points
		without variation in the use of grain in the production of bioethanol	with variation in the use of grain in the production of bioethanol	
EU	-5	+7,0	0	-7
EU	10	-15,6	-4,5	11,1
EU	5	-8,0	-0	8,0
World	5	-17,1	-3,5	13,6

Source: LEITAP.

Effect on the grain price in the event of a grain surplus

The effect of an above-average grain yield per hectare on the grain price depends on the demand price elasticity, i.e. the manner in which the grain price responds to the additional supply. This demand price elasticity is a function of a large number of factors including the substitution options available to the users of grain for consumption, industrial, cattle feed and energy (bioethanol) purposes in the EU-27. The sizes of the various components on the demand or user's side in the 2020 baseline scenario are shown in Table 4.1.

Calculations with LEITAP reveal that a 5% increase in the EU-27's production with an unchanged production in the rest of the world results in an 8% fall in the EU-27 price (Table 4.3). A 10% increase in the EU-27's production with unchanged production in the rest of the world results in a 15.6% fall in the price.

The demand price elasticity is then about -0.625. The effect of the extra production on the grain price is attenuated by the export of the grain surplus to the international market. On substitution with other products the other users' components also purchase additional grain when the grain price falls. Consequently when the policy remains unchanged this attenuates a further fall in price.

When the global grain yield per hectare is 5% above average then the EU-27 grain price is shown to fall even further, namely by more than 17%. This is then primarily due to the absence of the attenuation effect resulting from exports to the international market.

The withdrawal of surplus grain from the market has a substantial effect on the grain price (Table 4.3). An additional yield of 5% per hectare increases the total supply of grain by 13 million tonnes. This is less than the available import buffer for the import substitution of bioethanol, namely 7.25 billion litres or 18.7 million tonnes of grain. The EU's total grain surplus of 13 million tonnes is withdrawn from the market for the production of additional bioethanol. The import of bioethanol decreases in proportion and the EU-27 grain price remains constant in spite of the higher yield per hectare. In terms of the demand price elasticity the price-raising effect of the withdrawal of 13 million tonnes of grain is +8%.

A 10% higher yield per hectare will in the first instance result in an almost 16% fall in the grain price. Following the withdrawal of the grain surplus for the production of additional bioethanol the fall in price will be limited to about 4.5%. This means that pursuant to the 2020 baseline scenario and on the basis of the assumptions relating to the percentage incorporation obligation and bioethanol's share in the use of biofuel the full stabilisation of the grain price is not feasible in the event of a 10% increase in production. A ten per cent increase in production is equivalent to an additional 26 million tonnes of grain, more than the available import buffer that is equivalent to 18.7 million tonnes of grain. Part of the additional quantity of grain will not be used for the production of bioethanol and will need to be sold on the market. This will result in a lower grain price. However, the stabilising or price-raising effect on the grain price is substantial.

Table 4.3 does not take account of the option of storing surplus grain and using it to produce bioethanol at a later point in time. Nor does the table take account of the storage of extra bioethanol. When the extra-storage option is taken into account then the grain price can be stabilised in the short term irrespective of the size of the grain surplus.

When the average global grain yield per hectare increases with 5% the fall in price will be greater and the withdrawal of surplus grain for the production of grain will also have a major beneficial effect on the EU-27 grain price, i.e. a powerful stabilising effect in the EU-27 (Table 4.3). Given the assumptions of this study the price of grain can not be stabilised fully.

Effect on the grain price in the event of a grain deficit

Table 9 shows that a 5% below-average grain yield per hectare will result in an approximately 7% increase in the grain price. In this scenario a lower than average production of grain and reduced availability of grain is compensated by substitution with other products and (to a lesser extent) extra imports of grain. The EU-27 uses less grain to produce bioethanol. This has an attenuating effect on the further increase in the price of grain.

A 5% fall in the yield per hectare reduces the total supply of grain by 13 million tonnes. This is less than the more than 29 million tonnes of grain the EU-27 uses for the production of bioethanol (Table 4.1). Reducing the quantity of grain used for the production of bioethanol ensures that more grain is available for food and feed and that, even though the yield per hectare is below average, the grain price does not change (Table 4.3).

Price effects on other sectors, including bioethanol

The stabilisation of the grain price has a knock-on effect on other EU-27 prices, in particular of DDGS and bioethanol (Table 4.4). The fall in price of DDGS in the event of a grain surplus is due to the additional supply of DDGS resulting from the extra EU-27 production of bioethanol. The effect on the bioethanol price will be limited. The fall in the DDGS price will increase the net cost price of bioethanol. Part of this cost price will be passed on to the users of the bioethanol and will result in a slight increase in the price of bioethanol in the European market.

Table 4.4	Effect on the price of grain and other products following a variation in the EU-27's use of grain in the production of bioethanol in the event of a grain surplus or grain deficit			
	Change in production of grain relative to baseline scenario			
	EU			**World**
Price change	**-5%**	**+5%**	**+10%**	**+5%**
	grain deficit	**grain surplus**		
Grain	0	0	-4.5	-3.5
Other agricultural crops	0	0	-1.3	-7.3
Cattle feed excluding DDGS	0	0	-0.4	-0.4
DDGS	+5.7	-3.7	-9.8	-8.3
Bioethanol	-2.4	+1.4	0.4	0
Source: LEITAP.				

Table 4.4 shows that a 10% higher than average grain yield per hectare that creates a grain surplus which cannot be withdrawn in full due to an inadequate import buffer will result in a fall in the price of grain and other agricultural crops. The price of cattle feed will also fall slightly. However, the fall would have been much greater if this portion of the grain surplus had not been withdrawn from the market.

In addition, the stabilisation of the grain price in the event of a grain deficit can be seen to result in a lightly higher DDGS price. This is because less grain is used and less DDGS is produced. The bioethanol price can fall slightly in view of the slightly lower cost price.

4.3 Sensitivity analyses

The scenarios analysed in this study contain a number of assumptions that are incorporated in the model. However, there is some uncertainty about these assumptions. Firstly, a number of studies arrive a higher import percentage of bioethanol than used in this study, namely 50% rather than the 29% of the consumption of bioethanol in the 2020 baseline scenario. If this is the case then the price-raising effect of the withdrawal of surplus grain from the market in the event of a 10% above-average yield of grain in the EU-27 (and without the storage of grain or bioethanol) will be 15.6% (was 11.1%). This is because imports of bioethanol equal to 50% of the EU-27's use of bioethanol in the 2020 baseline scenario result in a larger bioethanol import buffer (imports of larger volumes of bioethanol). It will then also be possible to withdraw the grain surplus created by a 10% above-average production of grain in its entirety by means of import substitution with bioethanol.

The analysis of the short-term effects of the withdrawal of surplus grain from the market has until now been carried out using a model that is more suitable for the analysis of effects in the somewhat longer term that take account of changes in production methods. Although the model has been modified in a manner that complicates changes in production methods the demand price elasticity of grain would still appear to be relatively high.

However, the market intervention system that was used in the past complicates the calculation of the demand price elasticity of grain on the basis of fluctuations in prices and quantities in the past. This is because price decreases were limited to the intervention price level and upwards price movements were attenuated by bringing intervention stocks onto the market. The new system has greatly restricted grain interventions and it is conceivable that the grain price can fall to much lower levels, levels far below those seen in the past. For this reason Table 4.5 contains a sensitivity analysis carried out with a much lower demand elasticity in which an extra supply of grain has a much greater effect on the grain price. Table 4.5 also reviews the effect of an EU-27 net production of grain that is higher than in the 2020 baseline scenario. When the EU-27's net production of grain is higher and the volume of imported bioethanol remains unchanged then relatively less grain can be withdrawn from the market to substitute for imported bioethanol following an above-average grain yield per hectare. Consequently, the price-raising effect will be less pronounced.

Table 4.5	**Effects of the withdrawal of surplus grain with assumptions for the demand price elasticity of grain and the EU's total net production grain that are different from those in the 2020 baseline scenario**				
Price elasticity	**Total EU production (million tonnes)**	**Production change in the EU (%)**	**Price change in the EU relative to baseline scenario (%)**		**Price-raising effect in percentage points**
			without the withdrawal of surplus grain from the market for the production of bioethanol	**with the withdrawal of surplus grain from the market for the production of bioethanol**	
-0.625	260	+5	-8.0	-0	8.00
-0.3	260	+5	-16.67	0.00	16.67
-0.625	320	+5	-8.0	-0	8.00
-0.3	320	+5	-16.67	0.00	16.67
-0.625	260	+10	-15.6	-4.5	11.10
-0.3	260	+10	-33.33	-10.00	23.33
-0.625	320	+10	-15.6	-6.80	9.20
-0.3	320	+10	-33.33	-14.17	19.16

Source: LEITAP, researchers' calculations.

Table 4.5 shows that it is not possible to fully stabilise the grain price following a 10% increase in the yield per hectare. After the withdrawal of surplus grain for the EU's production of bioethanol and the import substitution of imported bioethanol the residual fall in price will be at least 4.5% and at most 14%, depending on the assumptions made for the demand price elasticity and the total net production (Table 4.5).

However, the withdrawal of surplus grain does have a stabilising, or price-raising effect. With a 10% increase in the yield per hectare this effect is greatest with a low price elasticity and a relatively low total net production. The stabilising or price-raising effect is then more than +23%. The stabilising or price-raising effect is lowest with a demand price elasticity of -0.625 and a relatively large EU-27 total net production. The price-raising effect is then in excess of +9%.

Table 4.5 also shows the price-raising effect with 5% extra production in the EU-27, which varies from +8% to +16.7% depending on the prevailing demand price elasticity. In all cases the grain price can be stabilised by withdrawing surplus grain from the market for the production of bioethanol.

5 Qualitative analysis of income effects

The withdrawal of surplus grain from the market for the production of bioethanol will have effects on the prices of the finished products of various sectors in the economy. In addition, the policy will have effects on the income earned in the various sectors. Consequently, the question is whether the stabilisation of grain prices also stabilises incomes. This chapter does not review the percentage changes in incomes in the various sectors in the various scenarios.

Table 5.1 shows that refraining from stabilising the grain price by withdrawing surplus grain from the market will result in a sharp fall in the income of grain producers and the producers of other agricultural products as compared to the incomes in the 2020 baseline scenario. In this instance bioethanol producers will be able to source larger quantities of grain at a lower price. This will result in an increase in the EU-27's bioethanol production and a decrease in imports of bioethanol that will decrease government income from import levies on bioethanol.

The stabilisation of the grain price by the withdrawal of surplus grain from the market for the additional production of bioethanol can improve the grain producers' incomes as compared to the 2020 baseline scenario. The favourable effect on the incomes of grain producers is estimated to amount to 1.82 billion euros as compared to the 2020 baseline scenario. This estimate is obtained on the basis of a grain price of EUR140 per tonne, a total production of 260 million tonnes, a demand price elasticity of -0.625 and a grain surplus of 5%. The beneficial effect on the grain producers' income is much greater when the demand price elasticity is lower. Table 5.1 also shows that the fall in income in the event that a grain surplus is not withdrawn from market is larger than the increase in income with a higher grain production and stable grain prices.

The stabilisation of the grain price by the withdrawal of surplus grain from the market can also increase the income of the EU-27's bioethanol producers as compared to the income in the 2020 baseline scenario. The detrimental effect of the lower DDGS prices is compensated by the beneficial effect on the volume and a slightly higher EU-27 bioethanol price. However, the extra capacity costs have not been taken into account. Once the grain stabilisation mechanism comes into operation with a grain surplus of 5% then an additional approximately 5 billion litres of bioethanol will be produced. The additional capacity investments will amount to approximately 5 billion euros (Vierhout, 2010). When the annual depreciation rate and rate of interest amount to a total of 10% the annual investment costs are estimated at 0.5 billion euros. Once the grain stabilisation mechanism comes into operation with a grain surplus of 10% then an additional approximately 10 billion litres of bioethanol will be produced. The additional capacity investments will then amount to approximately 10 billion euros and the annual costs to approximately 1 billion euros. The aforementioned additional investment costs can be limited by stock management. It would be logical to process a 10% grain surplus, a situation which occurs only once in 20 years, over a longer period of time. The same is applicable to a 5% surplus. However a 5% surplus is more frequent, once every 3 years, so the time available to process the surplus is more limited.

The EU-27's government income from import levies on imported bioethanol will fall sharply. On the basis of the assumptions and a 5% grain surplus the EU-27's loss of income is estimated to amount to about 0.4 billion euros.

Table 5.1 **Estimation of the fluctuation in income by sector as compared to the 2020 baseline scenario in the event of the development of a grain surplus and with or without stabilisation of the grain price**

Income	Without stabilisation of grain price	With stabilisation of grain price
Primary producers of grain	- - -	+
Primary producers of other agricultural products	-	0
Producers of bioethanol	+	+
Government (via income from import levies on bioethanol)	-	- -

From the above it can be concluded that the withdrawal of surplus grain from the market is beneficial to the income and the reduction of fluctuations in the income of grain producers. This is due to the relatively small demand price elasticity for grain, which results in large fluctuations in income. The fluctuations in the income in other agricultural sectors are also reduced when the grain price is stabilised.

Table 5.2 gives an estimation of the effect in incomes in a number of selected sectors in the event of a below-average yield per hectare and the resultant development of a grain deficit. In the first instance, the development of a grain deficit will result in a sharp rise in the grain price and an increase in the income of grain producers. This will also be applicable, to a lesser extent, to the incomes in the other agricultural sectors since higher grain prices result in higher prices in other agricultural sectors. The higher raw material costs will reduce the bioethanol producer's income. Imports of bioethanol will increase and government income from import levies on bioethanol will also increase.

When the grain price is fully stabilised by means of a further reduction of the EU's production of bioethanol from grain then the grain producers' income will decrease as compared to their income in the 2020 baseline scenario. However, the fluctuation in their incomes is limited as compared to the situation in which the grain price is not stabilised.

Table 5.2 **Estimation of the fluctuation in income by sector as compared to the 2020 baseline scenario in the event of the development of a grain deficit and with or without stabilisation of the grain price**

Income	**Without stabilisation of grain price**	**With stabilisation of grain price**
Primary producers of grain	+ + +	-
Primary producers of other agricultural products	+	0
Producers of bioethanol	-	-
Government (via income from import levies on bioethanol)	+	+ +

Table 5.2 shows that the bioethanol producers' income falls in the event of a grain deficit either with or without the stabilisation of the grain price. Although the raw material price is stable the production of bioethanol is now much lower. However, government income increases as a result of the additional imports of bioethanol.

Consequently, the question whether the stabilisation of grain prices by using a greater or lesser amount of EU grain for the EU production of alcohol also results in more stable incomes can be answered in the affirmative for the primary agricultural sector. However, the fluctuation in government income from import levies on bioethanol will increase. It is not possible to make an unequivocal assessment of the fluctuation in the bioethanol producers' income due to the counteracting price and quantity effects. A supplementary study will need to be carried out to resolve this.

6 Discussion and conclusions

The objective of this study was, in part using the LEITAP model, to examine the extent to which varying the use of grain in the EU-27's production of bioethanol could make a contribution to the stabilisation of grain prices and prices in the agricultural sector in general.

The literature concludes that large movements in price of the nature observed recently in agricultural markets are detrimental to the performance of the price mechanism relating to the determination of the optimum deployment of the scarce means of production. Price fluctuations also result in additional risks and repeated price negotiations with, for example, the retail sector. More stable prices result in more constant production that may be beneficial to the entire chain including the consumer.

In this study the imported quantity of bioethanol (the import buffer) and the quantity of grain used in the EU to produce bioethanol act as communicating vessels. In times of a grain surplus more grain is used for the EU-27's production of bioethanol and imports of bioethanol fall. Conversely, in times of a grain deficit less grain is used for the EU-27's production of bioethanol and imports of bioethanol rise. In this manner all scenarios comply with the incorporation obligation of a minimum 10% biofuel in the total fuel consumption. In addition, the assumption that bioethanol's share in the use of biofuel remains constant is met. In this study the variation of the use of grain in the production of bioethanol is not detrimental to, for example, biodiesel in complying with the incorporation obligation of 10% biofuels. Without this assumption variations in grain prices would be passed on to prices in the EU-27's other agricultural sectors.

The 2020 baseline scenario estimates bioethanol imports of 7.25 billion litres, an increase of almost 560% from the imports of bioethanol in 2008. The 2020 baseline scenario estimates the EU's total production of grain to amount to 260 million tonnes.

The results obtained with LEITAP indicate that the stabilisation of the grain price by varying the amount of grain used for the EU-27's production of bioethanol is, in principle, feasible. In view of the aforementioned preconditions, in the event of a 10% additional grain supply part of the extra grain will need to be stored to achieve full price stabilisation.

A more stable grain price also results in more stable prices in other agricultural sectors, in particular in the arable farming sector. In addition, the stabilisation of the grain price by varying the use of grain in the EU-27's production of bioethanol has an effect on the market for by-products obtained from the production of bioethanol (DDGS) and the EU-27 bioethanol market. In times of a grain surplus that results in increased EU-27 production of bioethanol the DDGS price will fall by between 4 and 10%. This decline in the price will have a limited effect on the price of bioethanol, which will slightly increase. Conversely, in times of a grain deficit and lower EU-27 production of bioethanol from grain the price of DDGS will increase and the price of bioethanol will fall. In this instance the increase in the DDGS price results in a decrease in the net cost price of bioethanol. Part of this gain is passed on to the user of the bioethanol in the form of a slightly lower price.

The study is based on a possible situation in 2020. There is uncertainty about a number of crucial variables, such as the total net production of grain (see Table 4.1) and the demand price elasticity of grain assumed in the 2020 baseline scenario. The demand price elasticity of grain indicates the degree to which the grain price changes on a specific change in the net production of grain. A sensitivity analysis carried out on the basis of the aforementioned variables shows that the extent to which price stabilisation is achieved decreases with an increase in the net production of grain and a decrease in the demand price elasticity of grain. The sensitivity analysis assumes a constant import of bioethanol and amount of grain for the production of bioethanol in the EU-27.

This study examined solely price fluctuations caused by variations on the supply side. However, the aforementioned method of stabilising the grain price will also achieve the required result in the event of changes in demand, provided that these changes are of roughly the same order of magnitude as the changes in supply.

The study did not examine the best approach to the implementation of the policy for the withdrawal of a greater or lesser quantity of grain from the market for the production of bioethanol. Nor did the study give an answer to the question as to the policy's effect on the utilisation and availability of bioethanol production capacity or the consequences of the policy for international trade.

The withdrawal of surplus grain for the EU-27's production of bioethanol can result in a fall in the grain price elsewhere in the world as it is assumed that this is accompanied by a change in the EU-27's imports of bioethanol. Imports of bioethanol will fall in times of a grain surplus and low grain prices in the EU-27. Consequently, the volume of bioethanol that would otherwise have been exported to the EU-27 will now need to be sold elsewhere.

The study did not extend to the possible effects of speculation and stock management, such as the storage of part of the surplus grain or additional output of bioethanol. The fluctuations in bioethanol imports caused by large variations in grain production and the use of grain in the EU-27's production of bioethanol as discussed above could be levelled by stock management tailored to forecasts of the fluctuations in production. Good stock management will avoid fluctuations in the plants' year-to year utilisation of their capacity. This was not included in the model used for this study and needs to be examined further.

The amendment of the European biofuel policy in the direction of the variation of the amount of grain used to produce bioethanol as referred to in this study could be beneficial to the environment (Hoekstra, 2010). This was not addressed in the current study.

Nor did the study examine the specific grain price at which the price should be stabilised: stabilising the grain price at too high a level could result in a longer-term surplus on the grain market that can no longer be absorbed by varying the use of grain in the EU-27's production of bioethanol.

In conclusion, uncertainty remains about the grain balance sheet in 2020 and the bioethanol market in 2020, in part due to developments within the context of the WTO. According to Banse en Grethe (2008), the further liberalisation of the grain market and bioethanol market could result in major shifts in the EU-27's use of grain in the production of bioethanol and bioethanol imports.

Literature

Banse, M., H. van Meijl, A. Tabeau and G. Woltjer, 'Will EU Biofuel Policies affect Global Agricultural Markets?' In: *European Review of Agricultural Economics* 35 (2008) 2, pp: 117-141.

Banse, M. and H. Grethe, *Effects of a potential new biofuel directive on EU land use and agricultural markets*. Paper prepared for presentation at the 107th EAAE Seminar 'Modelling of Agricultural and Rural Development Policies'. Seville, Spain, 29 January -1 February 2008.

Berkhout, P. and C. van Bruchem (eds.), *Landbouw-Economisch Bericht 2009*. Report 2009-047. LEI Wageningen UR, The Hague, 2009.

Biofuels Platform, *Production of bioethanol in de EU*. 2009. <www.biofuels-platform.ch>

CBS, *Duurzame energie in Nederland 2008*. The Hague/Heerlen, 2009.

European Commission (EC), *The impact of a minimum 10% obligation for bio-fuel use in the EU-27 in 2020 on agricultural markets*. AGRI G-2/WM D, Brussels, 2007.

EU, *Directive 2003/30/EC on the promotion of the use of bio-fuels or other renewable fuels for transport*. OJ L 123, 17.5.2003. European Commission, Brussels, 2003.

FAO, *Crop Prospects and Food Situation - No. 2 April 2009.* Rome, 2009 (via website www.fao.org).

Hertel, T.W. and M.E. Tsigas, 'Structure of the Standard GTAP Model'. Chapter 2. In: T.W. Hertel (ed.) *Global Trade Analysis: Modeling and Applications*. Cambridge University Press, 1997.

Hoekstra, K., Biobrandstofbeleid moet veranderen. In: *Agrarisch Dagblad* 8-4-2010, 2010.

International Energy Agency (IEA), *Biofuels for transport. An international perspective*. OECD Publishing, 2004.

Keane, M. and D. O'Connor, *Price Volatility in the EU Dairy Industry: Causes, Consequences and Coping Mechanisms*. University of Cork, 2009.

Klein, F. (red)., *Verbal communications*. 2010.

Meijl, van, H., T. van Rheenen, A. Tabeau and B. Eickhout, 'The impact of different policy environments on agricultural land use in Europe.' In: *Agriculture, Ecos. Envir.* 114 (2006), pp. 21-38.

OECD, *Economic Assessment of Biofuel Support Policies; Summary OECD report*. Presentation Press Conference, Paris, 16 July 2008 (via website www.oecd.org).

OECD, *OECD-FAO Agricultural Outlook 2009-2018*. Working documents. Paris, 2009.

Productschap Akkerbouw (PA), *Verbruik van granen voor de productie van bio-ethanol*. 2010 (via website www.agripress.nl).

Silvis, H.J., C.J.A.M. de Bont, J.F.M. Helming, M.G.A. van Leeuwen, F. Bunte and J.C.M. van Meijl, *De agrarische sector in Nederland naar 2020. Perspectieven en onzekerheden*. Report 2009-021. LEI Wageningen UR, The Hague, 2009.

USDA, *Bio-Fuels. EU Member States revise their biofuels policy 2008*. Washington DC, USA, 2008.

USDA, *EU-27 Biofuels Annual. Annual Report 2009.* Washington DC, USA, 2009.

USDA, *USDA Agricultural Projections to 2019*. Office of the Chief Economist, World Agricultural Projections Committee. Long-term Projections Report OCE-2010-1. 100 pp., Washington DC, USA, 2010.

Vierhout, R., *De Europese bioethanol industrie. Stand van zaken en vooruit-zichten*. Presentation during a meeting of the *Nederlandse Akkerbouw Vakbond*, Lelystad, March 2010.

Vlaams Infocentrum Land- en Tuinbouw (VILT), *Goedkope tarwe stuwt productie bio-ethanol in EU*. 2009 (via website www.vilt.be).

Appendix 1

Biofuels in the Netherlands

European policy provides for the obligation to incorporate biofuel (bioethanol and biodiesel) in fossil fuels used for road transport. The Netherlands began to introduce biofuels in the market in 2006. The total sales of biofuel for road transport ultimately amounted to 67 million litres in 2006, equivalent to 0.4% of the energy content of the petrol and diesel sold on the Dutch market. In 2005 biofuel's share had been 0.02%. This relatively large increase was due to the promotion of the incorporation of biofuels in fossil fuels with a tax incentive entailing a reduction of the fuel duty. This fuel duty exemption was subsequently abolished in 2007. However, at the end of 2006 the Netherlands allocated a total of 60 million euros to subsidies for innovative biofuel projects designed to achieve a substantial reduction of CO_2 emissions. This subsidy scheme will terminate at the end of 2006.

In 2007 an obligation was imposed on suppliers of petrol and diesel for road transport to bring a minimum proportion of petrol and diesel in the form of biofuel on the market. In 2007 this minimum proportion amounted to 2%, which was subsequently to increase by annual 1.25% increments to 3.25% in 2008, 4.50% in 2009 and 5.75% in 2010, all in accordance with the Directive. However, these percentages are targets and the member states are not under the obligation to implement these levels. There has been a great deal of social and political discussion about the desirability of biofuel for road transport. One of the disadvantages of the use of biofuel that is often cited is the effect on greenhouse gas emissions, which are reduced to a limited extent and may even increase when account is taken of all the - often indirect - factors. Biofuels can, in view of the nature of the raw materials used to produce them, compete with food that can then become more expensive. As a result of these discussions the Ditch government has in any case decided to reduce the minimum incorporation obligation from 4.5 to 3.75% for 2009 and from 5.75 to 4.0% for 2010.

In 2007, petrol and diesel suppliers were permitted to supplement the incorporation of biofuel in the fuels by bringing special biofuel mixtures (such as 5% bioethanol and 95% regular petrol or 85% bioethanol and 15% regular petrol or 5% biodiesel and 95% regular diesel) or even pure biofuels on the market that enabled them to fulfil their obligation. In general, in 2007 the suppliers opted for the incorporation of biofuels in fossil fuels that were marketed as 'ordinary' petrol and diesel.

Production of bioethanol in the Netherlands

The Netherland's production of bioethanol, 9 million litres in 2008, is of a relatively limited scale. Until now, virtually all bioethanol produced in the Netherlands has been made from residues from the agricultural sector. Bioethanol produced using this raw material is designated as a second-generation biofuel. First-generation biofuel is made from food crops such as grain and maize. Experiments are also being carried out on a third-generation biofuel produced from algae that are cultivated specifically for this purpose.

The Netherlands' share of the EU's total production of bioethanol is just 0.3%. The Netherlands currently has just one bioethanol producer, Koninklijke Nedalco in Bergen op Zoom. Nedalco, a subsidiary of the COSUN food concern, is originally a producer of natural alcohol for the beverages industry and for applications in sectors including the cosmetic and pharmaceutical industries. The company plays a leading role in Europe in this field. In 2005 Nedalco expanded its operations to include the production of bioethanol from low-grade residues from the agro-industry. The Bergen op Zoom plant produces bioethanol from sugar beet molasses. The Sas van Gent plant produces pure alcohol from grain and maize and bioethanol from wheat starch residues. These residues are sourced from the neighbouring Cerestar grain company, a member of the Cargill group. In 2007 Nedalco had plans for substantial investments in a large-scale plant for the production of second-generation biofuels. On 1 March 2007, the company announced that a bioethanol plant would be built at Sas van Gent with an annual capacity of 200 million litres of bioethanol that would come on stream at the end of 2008. Nedalco would then be one of the world's first producers to produce second-generation biofuels on an industrial scale. The process would be based on the use of a yeast developed and patented by the company which is capable of converting wood sugars into bioethanol. However, the volatility on the raw materials market and the market developments resulted in the decision to postpone the construction of the new plant and the plans were mothballed. However, the plans to build a plant in Groningen that would produce bioethanol from sugar beet (first-generation bioethanol) have been abandoned. The Board explains this decision as follows in COSUN's Annual Report 2008:

'Owing to the poor return in the bio-ethanol market, Nedalco has decided to produce virtually no first-generation bio-ethanol. Political support in the EU for biofuels has ebbed away, partly as a result of the presumed relationship with food prices. New second-generation technology is promising but willingness to encourage its use in Europe has so far been exceptionally disappointing.'

In contrast, in 2010 Spain's Abengoa Bioenergy company will begin to produce bioethanol in Rotterdam from maize or wheat (depending on the price of the raw material). The estimated production capacity amounts to 480 million litres, which will require between 1.1 and 1.4 million tonnes of wheat or maize. Should these plans materialise then the Netherlands will (on the basis of data from 2008) become the EU's third largest producer of bioethanol.

The Netherlands is already the EU's largest importer of bioethanol. The bioethanol is imported to Rotterdam, where it is blended with petrol destined for the German market.

Appendix 2

Production capacity (PC) under construction (in million litres)

MS	Company	PC	Feedstock
Bulgaria	Euro Ethyl GmbH (Silistra)	30	Maize
	Crystal Chemicals	13	
Denmark	Dong Energy (Kalundborg)	17.6	Straw, wheat
France	Roquette (Beinheim)	35	Wheat
Germany	Wabio Bioenergie (Bad Köstritz)	8.4	Waste
	ESP Chemie GmbH	140	
Hungary	First Hungarian Bioethanol Kft (Elsö Magyar Bioethanol Termelökst)	90	Maize
Lithuania	Bioetan	100	Cereals
Netherlands	Abengoa (Rotterdam)	480	Wheat
	Nivoba BV (Wijster)	100	Cereals
Slovenia	Slovnafta (Bratislava)	75	Wheat
Spain	Biocarburantes Castilla & Leon (Salamanca)	5	Ligno-cellulose
	SNIACE II (Zamora)	150	Wheat
	Alcoholes Biocarburantes de Extremadura (Albiex)	110	
UK	Ensus plc (Teesside)	400	Wheat
	Vivergo (Hull)	420	Wheat
Total		2,174	

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Source: eBIO.

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