Modelling the impacts of macro-economic variables on the South African biofuels industry

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Abstract

The production of biofuels from agricultural commodities has received much attention in recent years. Apart from a few private initiatives, biofuels have not seen a large scale, commercial production in South Africa to date. This article sketches a basic picture of the economic feasibility of biofuel production in South Africa, without any form of government support, at 2006 prices. It then takes the analysis a step further and with the aid of a set of scenarios, different potential outcomes, due to a range of possible policy implementation measures, are discussed and the results documented. The Bureau for Food and Agricultural Policy's (BFAP) sector model is used to simulate the impact of various options on the potential biofuels industry and other related industries during the course of the 2007 to 2015 period. This study shows that a lack of government support for the local biofuels industry could seriously affect its economic viability, especially in the early stages of the industry's development. Additional issues, such as the impact on food and feed prices, also need to be taken into consideration.

Keywords: Biofuels draft strategy; government support; economic feasibility

1. Introduction

In the past year the world has witnessed considerable developments in the global production and production capacity of biofuels. Given recent large carry-over stocks and the resultant low prices of grains, individuals in South Africa and more recently also government officials have proposed the idea of establishing a national mandate for biofuels. Both yellow maize and the production of bioethanol from sugar have sparked the interests of many role-players in the industry. There are also other drivers at work, which have implicitly involved policy-makers in the debate on biofuels. One of these is the government's commitment to comply with the framework of the Renewable Energy White Paper, which necessitates the production of renewable energy of 10 000 GWh by 2013 of which a certain percentage has to come from the production of biofuels. The preliminary target which the government aims to

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achieve is to replace 4.5% of the local petrol and diesel supply with biofuels by 2013. The possibility of a successful biofuels industry creating improved market access for black emerging farmers, who could produce suitable crops under contractual arrangements, has also been extensively debated in government circles.

In order to analyse the potential impact of an emerging biofuels industry on the rest of the South African agricultural sector, the dynamic interaction between field crops, livestock, biofuels and government policies has to be taken into account. The field crops are the source of supply and, as a result, their prices will influence the competitiveness and feasibility of the biofuels industry. The livestock sector acts as the uptake market for the by-product, which implies that the price at which the by-product sells is determined in the livestock market. Depending on how government structures the policy and incentive programme, the price of bioethanol and biodiesel could mainly be a function of the retail price of fuel. The Bureau for Food and Agricultural Policy (BFAP) sector model has been developed to serve the purpose of simulating the dynamic interaction between various industries over time. The BFAP model is used in this study to simulate the impact of various policy options on the biofuels industry and related industries over the period from 2007 to 2015.

The literature review section of this article is followed by a brief explanation of the BFAP sector model. The article then discusses the current economic feasibility of biofuel production in South Africa, without any form of government support, at 2006 prices. Subsequently the analysis is taken a step further, and by means of using a set of scenarios, different potential outcomes, due to various possible policy implementation measures, are discussed and the results documented. The concluding remarks make up the final section of the article.

2. Literature review

In South Africa very little research has been done on the feasibility and the potential impacts of a biofuels industry on the local commodity market. Research institutions such as BFAP are among the few entities that have developed models to assist decision-makers in analysing the impacts that their respective policies will have on the biofuels industry. Findings indicate that factors such as import tariff protection, tax exemptions, mandates, the location of the biofuel production plants and the feedstock used for biofuel production all play an important role in the sustainability of such an industry (BFAP, 2007).

The importance of the correct set of biofuel policies has been highlighted by the global ethanol industry and this advice has specifically been applied to the ethanol industry in the United States of America (USA). De Gorter and Just (2007) have found that a tax credit together with a binding mandate becomes a subsidy for fuel consumers and only indirectly benefits ethanol producers, namely if ethanol prices increase due to an increased demand for ethanol. In this study a similar policy structure is applied to the South African context as discussed by De Gorter and Just context except that the South African situation also includes a set of import tariffs, in order to restrict market access to the international competition.

There are also a number of alternative policy structures available, as discussed by Tyner (2007). These include the renewable fuel standards that are currently in place in the USA, which the author suggests should remain unchanged in future in order to allow the economics thereof to be resolved. The second policy structure he proposes is a two part subsidy. Tyner (2007) argues that such a subsidy is directly derived from energy security and climate change externalities and will therefore be calculated based on the energy content of the renewable fuel. A similar idea would also apply to the environmentally friendly nature of biofuels and based on these values, the various fuels would qualify for different levels of subsidies. According to Tyner (2007), the subsidy for biodiesel would be 1.5 times larger than that of bioethanol since it has 150% of the energy content of ethanol. The approach that Tyner (2007) follows works with the idea that cellulosic ethanol will play an important role in future and his third policy structure stresses that such incentives should be acknowledged and supported. He argues that if the state wants to provide incentives for the industry to move towards cellulose sources instead of corn, then targeted incentives might be appropriate. Again, this would depend on the strategy that the government would wish to follow. An alternative fuel standard and an alternative fuel standard with a variable subsidy were the other two variable policy structures that were mentioned. The alternative fuel standard would require the industry to purchase a certain percentage of the total fuel supply from either alternative or renewable fuel sources. Alternative fuel sources include all fuel from non oil resources, such as coal for example. A variable subsidy together with an alternative energy resource would secure fuel producers in instances of extremely low oil prices. In such instances, the state would carry some of the risk but, importantly, the variable subsidy would not share the risk of low technical progress in reducing the cost of alternative fuels (Tyner, 2007).

A number of outlooks have been completed in an attempt to project the future use of ethanol in the United States. The long-term projections of the United States Department of Agriculture (USDA) show average corn prices reaching

$3.75 per bushel in the 2009/10 marketing year and then declining to $3.30 per bushel by 2016/17 as ethanol expansion slows. The USDA's projections further indicate that the intention to plant corn will increase and lead to a peak in plantations of around 90 million acres in 2009/10, based on the expansion within the ethanol industry (Westcott, 2007). The Centre for Agricultural and Rural Development at the Iowa State University makes use of a multi–product, multi–country partial equilibrium model and has in its paper, entitled *Emerging Biofuels: Outlook of Effects* (2007), evaluated a set of three scenarios. The authors found that higher oil prices combined with an adoption of flexi fuel vehicles resulted in equilibrium corn prices rising to more than $4.40 per bushel and that this could mean an increase in beef, poultry and pork prices by as much as 4%, while an 8% increase in the price of eggs could be expected (Tokgoz *et al*., 2007). In South Africa, BFAP has also issued a baseline in which it highlights that a relatively low blend of biofuels into the liquid fuels pool will result in the increase of white and yellow maize prices, if these commodities are to be used in the production of biofuels (BFAP, 2007). Slight increases in prices can also be expected for sugar cane and some of the oilseeds, but these price hikes are largely linked to the international market. In short, authors see the upward pressure on international prices due to an increase in the demand for commodities as being the one of the main results of the production of biofuels.

The following sections of this article explore a set of scenarios and the impacts that the production of biofuels could have on the agricultural sector in South Africa.

3. The BFAP Sector Model

The BFAP sector model is a dynamic system of econometric equations, which has the ability to model cross-commodity linkages. The first version of the South African grain, livestock and dairy model was developed and operationalised by Meyer and Westhoff in 2003 (Meyer & Kirsten, 2005). It can be classified as a large-scale multi-sector commodity level simulation model and includes six crops, five livestock and five dairy commodities, together with a new section simulating the fuel market where petrol, diesel, ethanol and biodiesel are incorporated. The model is maintained within the BFAP at the Universities of Pretoria, Stellenbosch and the Department of Agriculture Western Cape. It is directly linked to the global models of the Food and Agricultural Policy Research Institute (FAPRI) and indirectly linked to the Computable General Equilibrium (CGE) models that are maintained by the Provincial Decision-Making Enabling (PROVIDE) group. The PROVIDE project, which is situated at the Western Cape Department of Agriculture, attempts to facilitate policy decision–making at the national and provincial level by providing quantitative policy information. Twenty six commodities are simulated in detail in the BFAP model. These commodities can be classified into the following four main industries; Livestock, Biofuels, Field crops and Horticulture. Figure 1 illustrates the linkages between the various industries and the list of exogenous variables that could cause a shock to the equilibrium in the market as simulated by the system of models.

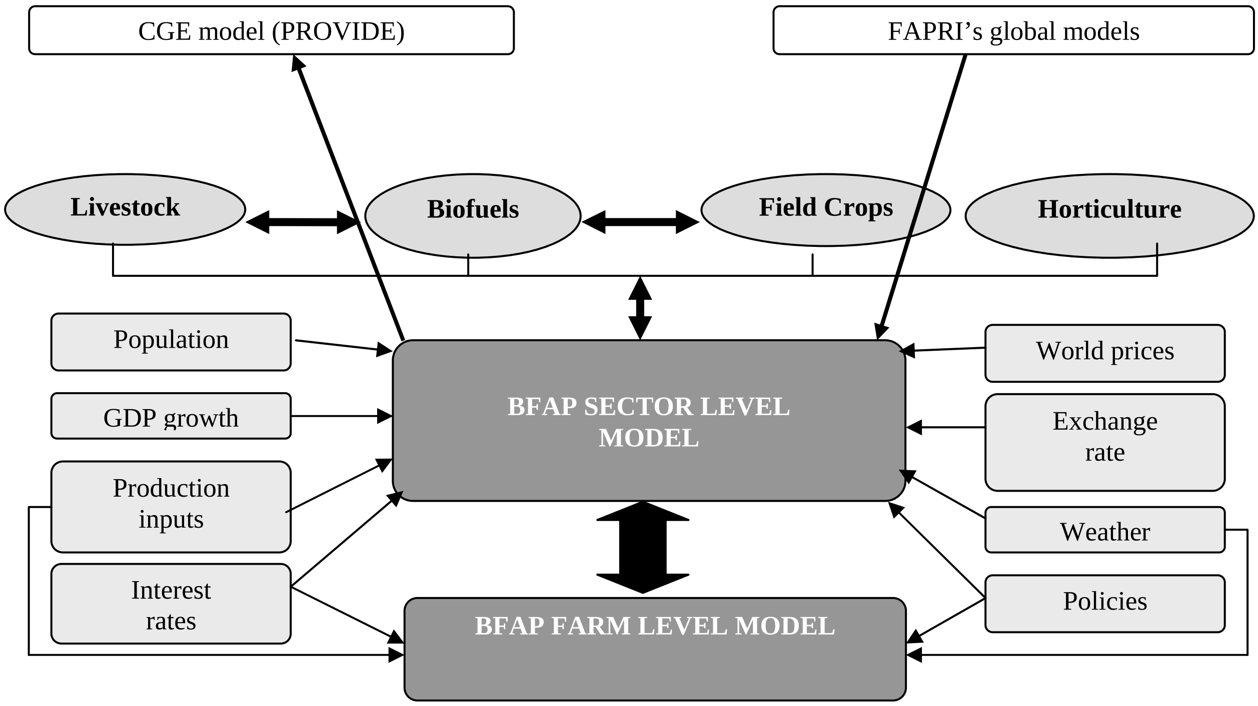

Figure 1: Basic structure of the system of equations for the BFAP model

It is important to note is that the model simulates for a dynamic equilibrium between all of the markets over time. For example, biofuel production will only commence in the model if positive profit margins can be obtained in the market. These profit margins depend on, among other things, the price of feedstock like maize and sugar and the price of their by-products (Section III of the paper discusses the calculation of the profit margins in more detail). Therefore, if the production of biofuels under a certain set of conditions is economically viable, a new equilibrium will be simulated for all the industries in the model. For example, the maize and sugar prices will be higher due to increased domestic demand. In addition, the higher cost of grain and the supply of dried distillers grain (DDG) (a by-product in the production of bioethanol from maize) will impact on the livestock industries through feed rations for each of the livestock industries. Also, higher feed costs will cause the production of poultry meat to decrease and chicken prices to increase. All the determinants of supply and demand (production, consumption, imports, exports and prices) for each commodity have been identified.

4. The current state of affairs

Agricultural commodities that have been used in this analysis include sugar cane, yellow maize, soybeans and sunflower seed. The BFAP model only takes these commercial agricultural commodities into account, but it is acknowledged that there are other commodities that could also contribute to the production of biofuels. A certain set of prices and costs has been used to calculate these potential profits. In Figure 2 below, the first two columns represent the profits/losses which a plant producing bioethanol may incur, while the third and fourth column are representative of profits/losses which are to be earned by biodiesel producers. Figure 2 clearly shows that no commercial crop will yield a positive plant profit by producing biofuel under 2006 market conditions. Interestingly, there is not much choice in producing bioethanol from sugar or maize under 2006 market conditions.

Although the potential profit of selling soybean and sunflower oil in the human vegetable oil market is not represented in the graph, industry specialists argue that positive profits are obtained in this industry. Comparing the fuel and human vegetable oil markets is not very complicated. In the fuel market, the biodiesel obtained from soybeans sells for 336.45 SA cents per litre at plant level whereas in the human vegetable oil market, soybean oil is sold at plant level for approximately 529.47 SA cents per litre. In the case of sunflower seeds, a similar situation exists. Biodiesel from sunflower seeds sells for 336.45 SA cents per litre, while sunflower oil sells for 555.23 SA cents per litre in the human market. Even though the price at which sunflower oil is sold is higher than the price at which soy oil can be sold, the prices at which the by-products trade in the feed market create a more profitable environment for soybean producers. Apart from locking in positive plant profits, any form of incentive for the production of biodiesel will thus have to be structured in a way to ensure that vegetable oil sales will be diverted from the human market to the biodiesel market.

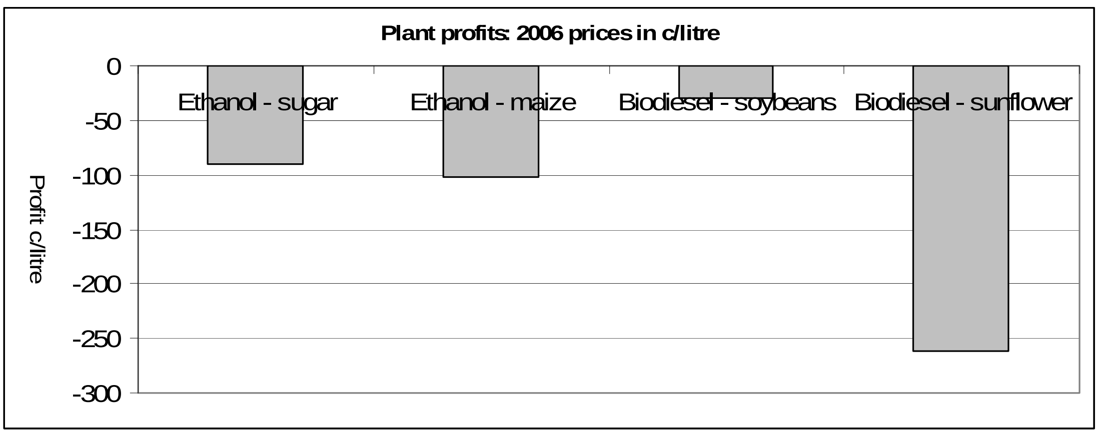

Figure 2: Bioethanol and biodiesel plant profits for different agricultural commodities

Table 1 represents the prices that were used in the calculation of plant profits. All the prices are generated in the BFAP sector model under a combination of assumptions. For example, one assumption is that bioethanol sells at 95% of the basic fuel price and that biodiesel sells at 100% of the basic fuel price (Department of Minerals and Energy, 2006). The macro-economic variables and world prices that were used for these simulations are presented in Section IV and Tables 2 and 3.

Table 1: Plant profit calculations, 2006 average prices

Commodity*	Cost of feedstock (R/ton)	Income from by-product (R/ton)	Income from sales (c/litre)	Total costs of production (c/litre)	Profit (c/litre)
Sugar cane (Eth)	193	-	312.91	402.81	**-89.87**
Yellow maize (Eth)	1310	1092	312.91	414.637	**-101.80**
Soybeans (BIOD)	1959	2076	336.45	366.3	**-29.87**
Sunflowers (BIOD)	2338	1505	336.45	598.55	**-262.27**

** Abbreviations of biofuels: Eth – Ethanol and BIOD – Biodiesel*

The total cost of production figure includes all costs incurred by the processing plant. These are variable and capital costs, the cost of feedstock incurred by the processor and the income earned from the selling of the by-product to the animal feed industry. The costs and conversion ratios were obtained from financial institutions and technology providers. Another important assumption is that these costs are representative for an "average sized plant" and the authors of this article acknowledge that the cost structures for different sized plants will differ from the values that are presented in Table 1.

The technical factors with respect to extraction rates of ethanol, vegetable oil and by-products have been benchmarked by using data and norms received from industry role-players and international experience. An ethanol from sugar cane extraction rate of 76 litres per ton, an ethanol from maize extraction rate of 402 litres per ton, a biodiesel from soybean extraction rate of 194 litres per ton and a biodiesel from sunflower seed extraction rate of 398 litres per ton are applied in the model. DDG from maize has an extraction rate of 304 kilograms per ton, soy cake an extraction rate of 800 kilograms per ton of soybeans and sunflower cake a rate of 420 kilograms per ton of sunflower seed. In contrast to the knowledge that exists of the production and consumption of oilcake in South Africa, there still exists uncertainty with respect to the quality of DDG that will be produced and the level of uptake at a specific price. An average quality of DDG is assumed for this model.

The authors of this article acknowledge that there are some by-products which could potentially add more value to the gross margins, but at the present point in time it is difficult to determine a price series for these. In the case of the sugar cane to ethanol process, bagasse should definitely be taken into account, due to its potential as a raw material for electricity generation. Carbon dioxide (CO_2) sequestration from the fermentation process could also be taken into account as this product could also fetch a value in the market. In the maize to ethanol process, the value of $C0_2$ and the value of gluten oil have not been taken into account.

5. The impact analysis

The impact analysis is conducted by comparing various scenarios to baseline projections. The first basic projections generated by the sector level model are called "Deterministic Baseline projections". They serve as a benchmark or the "most likely" outcome if no major shock occurs within the sector. These projections are a simulation of the sector-model under a set of assumptions regarding the grain sector, macro-economy, agricultural policies, weather and technological change. The basic technical assumptions regarding the potential biofuel industry, as represented in the previous section, have been included in the model, but no assumption has been made with respect to any government support.

Once the baseline has been set, two possible future scenarios are simulated in the model and the results are compared to the baseline. The first scenario is called "*South Africa's green revolution*" and the second scenario "*South Africa's green but bleak future*".

5.1 Baseline

In terms of sector-level assumptions, for the baseline scenario it is assumed that there is no change to public investment in logistical infrastructure for the grain industry and therefore no reduction in the transportation and storage costs of grain. Also, it is assumed that no private-sector investment in the bio-fuel industry is taking place due to the absence of enabling policies.

The macro-economic and world commodity price assumptions are based on forecasts prepared by a number of institutions. These include Global Insight, the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri, ABSA bank and the Actuarial Society of South Africa. They are presented in Table 2 and Table 3 respectively.

Table 2: Economic indicators – baseline projections 2007 - 2012

Item		2007	2008	2009	2010	2011	2012
Crude Oil Persian Gulf: fob	$/barrel	63.22	60.79	57.01	53.44	51.41	50.33
Population	Millions	47.68	47.65	47.54	47.39	47.22	47.04
Exchange Rate	SA c/US$	751.75	792.38	824.63	851.67	869.81	886.89
Real per capita GDP	R/capita	17600.81	18390.69	19233.4	20120.7	21042.24	22017.87
Consumer Price Index – Food (Inflation)	(2000=100)	217.55	227.28	237.37	247.18	257.23	267.53

Source: Global Insight, FAPRI, Actuarial Society, ABSA, as quoted in the 2006 BFAP baseline

Table 3: World prices – baseline projections 2007 - 2012

Item		2007	2008	2009	2010	2011	2012
Yellow maize, US No.2, fob, Gulf	US$/t	161.00	143.01	145.66	145.87	146.33	145.44
Wheat US No2 HRW fob (ord) Gulf	US$/t	178.17	177.05	180.26	181.84	184.00	185.58
Sorghum, US No.2, fob, Gulf	US$/t	177.55	177.66	180.93	182.09	183.61	183.74
Sunflower Seed, EU CIF Lower Rhine	US$/t	338.24	343.53	348.44	343.27	335.93	331.01
Sunflower cake (pell 37/38%) , Arg CIF Rott	US$/t	122.32	120.86	120.28	119.49	118.89	117.51
Sunflower oil, EU FOB NW Europe	US$/t	726.01	729.93	732.82	737.66	743.40	747.45
Soya Beans seed: Arg. CIF Rott	US$/t	328.30	343.84	343.82	340.34	335.77	333.66
Soya Bean Cake(pell 44/45%): Arg CIF Rott	US$/t	245.49	249.36	244.55	236.84	231.76	228.98
Soya Bean Oil: Arg. FOB	US$/t	648.43	684.69	698.42	712.77	714.35	716.18

Source: FAPRI, 2006, BFAP adjustments

5.1.1 Scenario 1: South Africa's green revolution

The government decides to implement an E10, 10% bioethanol blend, and a B5, 5% biodiesel blend, mandatory blending policy in 2008, as it is keen on achieving its 2013 renewable energy goals and expects that its policy on renewable energy will uplift emerging and small-scale farmers, if managed correctly.

The government is very conscious of what is happening within the global biofuel industry and understands that it is nearly impossible for such an infant industry to survive without any support. Under this scenario, it is assumed that the government will implement a set of policies designed to encourage the development and production of bio-fuels. These policies include;

1) Blending mandate: The bioethanol policy is gradually phased in, changing with 2% blending every year until a 10% blend is achieved. The biodiesel mandate is also systematically phased in from 2008

onwards, with a 2% blending mandate at first. This is then upgraded to a 5% mandate from 2010 onwards.
2) Fuel Tax Rebate: A 40% tax rebate on both biodiesel and bioethanol is legislated in 2007 and is increased to 50% in 2008.
3) Import tariffs: The financial survivability of the local industry is supported by the introduction of import tariffs (30% on ethanol and 30% on biodiesel) in 2011.
4) Fuel prices: The fuel prices have been solved in a system of equations and represent what the prices should be in the presence of external economic forces.

5.1.2 Scenario 2: South Africa's green but bleak future

The government recognises the potential of increasing employment opportunities and productivity in the agricultural sector if the biofuels industry is supported. In fact, the government regards this as one of the key areas in order to achieve a 6% growth rate in the agricultural sector. In order to achieve this potential, the government reduces taxes, in other words, gives a tax levy reduction of 50% to both the biodiesel and bioethanol producers. However, the Department of Trade and Industry also wants to stay on good terms with the World Trade Organisation (WTO) and, as a result, does not have the intention to implement a protective import tariff for the biofuel industry. Large investment companies are reluctant to invest in the local biofuel industry because they are of the opinion that the local industry will not be able to compete internationally in the long-run.

In this scenario an assumption is made that the 50% tax levy reduction only applies to locally produced biofuel and not to any imported fuel. Most importantly, in 2011 the government abolishes the reduction in fuel tax policies, as it argues that the mandatory blending policy provides more than enough of an incentive to start producing biofuels economically.

The following set of policies is introduced under this scenario:
1) Blending mandate: The government decides to phase in an ethanol mandatory blending requirement, starting with 2% in 2008 and increasing gradually to 8% in 2011. The government, furthermore, decides to implement a biodiesel mandatory blending policy, starting off with 2% in 2008, which is then kept constant.
2) Fuel Tax Rebate: A 40% tax rebate on both biodiesel and bioethanol is legislated in 2007 and is increased to 50% in 2008.
3) Import tariffs: There are no import tariffs on biofuels.

4) Fuel price: The fuel price has been solved in a system of equations and represents what the price should be in the presence of external economic forces.

5.2 Simulation results

The combination of external shocks in the form of policies and macro-economic variables is introduced in the model and a new equilibrium is simulated for each of the scenarios. Equilibrium is reached when supply equals demand for each of the commodities in the model. The output from each scenario can be seen as the specific deviation from the previous state. Only the output of selected variables will be presented.

5.2.1 Scenario 1: The ethanol industry

The model indicates that in the first year, 2008, all ethanol which is required to satisfy the local market will be imported. Ethanol production is likely to commence from 2009 onwards, when the first maize and sugar to ethanol plants come into production. No bioethanol is produced until a mandatory blending requirement is introduced because plant profits are negative under baseline conditions where no policies or incentives are introduced. It is interesting to note that in the long run, more ethanol will be produced from sugar than from maize. It is only in 2012 that local ethanol production finally exceeds the imports of ethanol. Imports continually decrease, but still play a role in satisfying the local demand. It is projected that by 2015 just over 900 million litres will be produced locally of which 464 million litres will be produced from sugar and 437 million litres will be produced from maize.

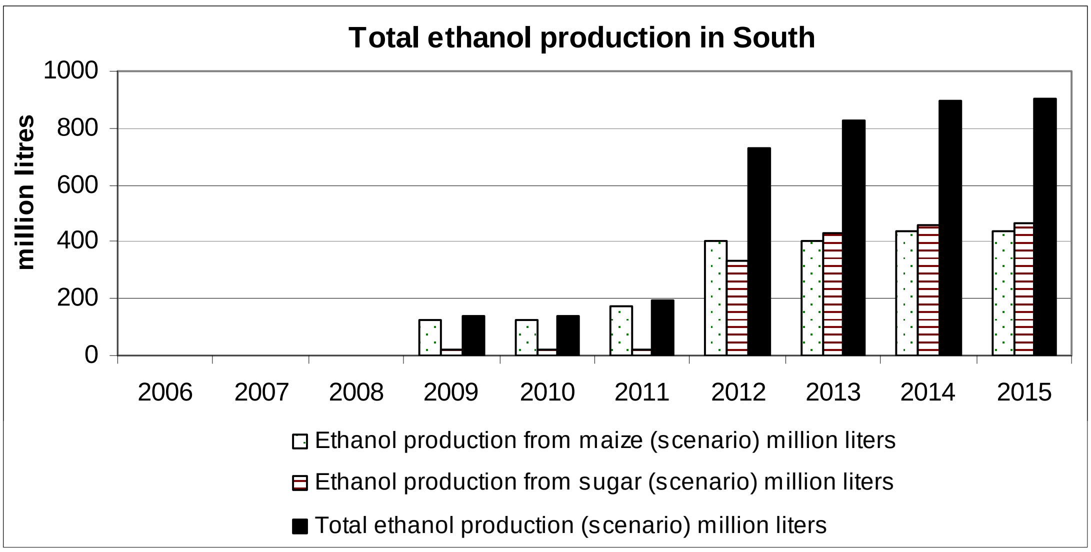

Figure 3: Scenario 1: Total ethanol production in South Africa

As the sale of the by-product plays an important role in the economic feasibility of an ethanol plant, it is of the utmost importance that the price variations of these products and its uptake limitations within the South African feed industry are well understood. Figure 4 indicates how DDG production and yellow maize and DDG prices move together over time.

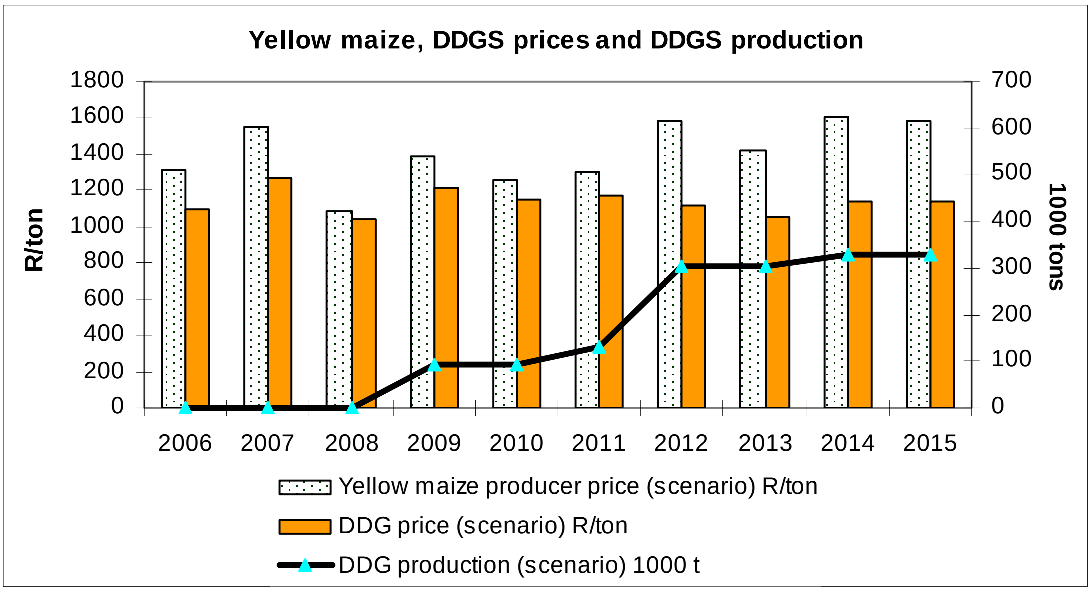

Figure 4: Scenario 1: DDG production, yellow maize and DDG prices

After the authors of this article consulted with industry experts in the feed industry, they determined that average quality DDG will be demanded at competitive prices up to a level of approximately 300 000 tons, after which prices could come under pressure. In scenario 1, DDG production levels are at approximately 330 000 tons. At these levels, the model projects DDG prices to start trading at a discount compared to the projected yellow maize prices. The yellow maize price increases as the production of biofuels drives up the demand for yellow maize. As previously mentioned, consumption levels and the prices at which DDG will trade in the local market are still uncertain and various modelling approaches can be used to enrich the debate.

Figure 5 illustrates the impact of biofuel production on the local white and yellow maize prices. On average, white and yellow maize prices increase by 12% and 18% respectively in the long-run (2012 to 2015). It has to be mentioned here that these projections are simulated under normal weather conditions. The model projects a net increase in total consumption of maize of approximately 650 000 tons per annum. Under normal weather conditions, South Africa can easily produce a surplus of 650 000 tons and only a moderate increase in prices can be expected. However, under drought conditions it can be expected that the local maize industry will move to an import parity scenario much faster if maize is used for the production of ethanol. The total area under maize production is projected to increase by an annual average of 176 000 ha for the period 2012 to 2015, partly at the expense of the area on which other field crops have been planted. The net increase in the total area on which field crops have been planted is in the order of 140 000 ha.

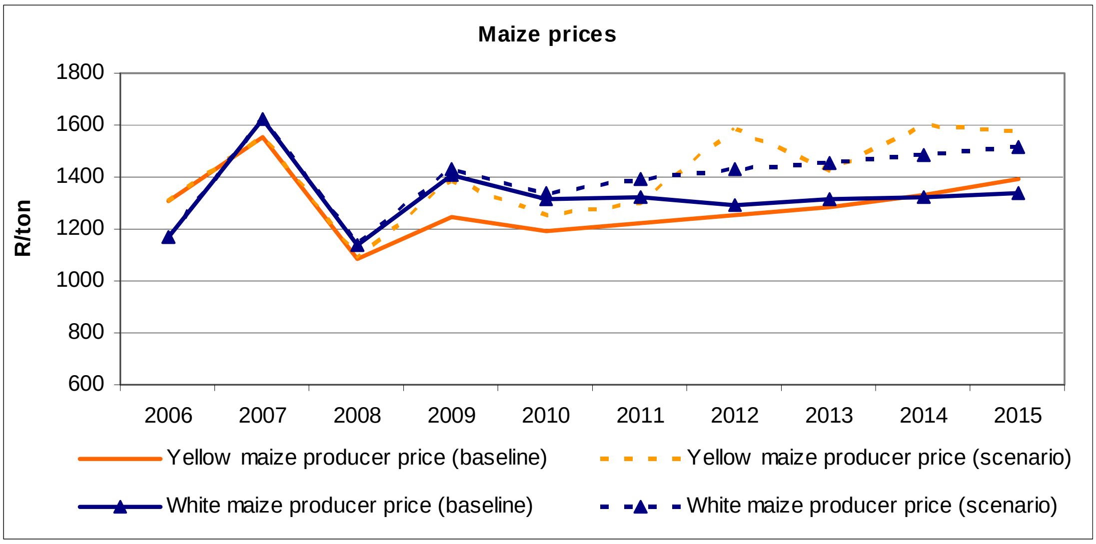

Figure 5: Scenario 1: White and yellow maize SAFEX prices

Table 4: Yellow maize balance sheet – absolute change from baseline

		2012	2013	2014	2015
Yellow maize area harvested	1000ha	101.5	237.4	154.0	211.3
Yellow maize average yield	t/ha	0.0	0.0	0.0	0.0
Yellow maize production	1000 tons	378.1	893.8	585.5	811.2
Yellow maize feed consumption	1000 tons	-487.6	-266.3	-396.8	-312.8
Yellow maize human consumption	1000 tons	-17.3	-7.1	-13.8	-9.7
Yellow maize ethanol use	1000 tons	996.1	998.4	1084.6	1086.9
Yellow maize domestic use	1000 tons	491.2	725.0	674.0	764.4
Yellow maize ending stocks	1000 tons	-11.1	174.7	117.4	186.2
Yellow maize exports	1000 tons	-6.8	-2.8	-5.3	-3.6
Yellow maize imports	1000 tons	34.4	13.9	26.5	18.3
Yellow maize producer price	R/ton	337.0	139.1	268.4	189.3

Table 4 presents the absolute changes from the baseline in a balance sheet format for yellow maize. This table clearly illustrates the strength of the partial equilibrium framework that is applied in the BFAP sector model to simulate for dynamic market equilibrium over time. The interaction between industries is also taken into account. For example, white maize prices increase because the area under maize production planted will decrease as the area under yellow maize production expands.

The impact on the sugar market is much smaller than the impact on the maize market. This is because only exported sugar is diverted to ethanol production. Interestingly enough this only occurs once the import tariff on imported ethanol is implemented in 2011. The sudden diversion from exports forces the local sugar cane price up and it increases on average by 4.9%. The production of ethanol from sugar does not shift the local market from producing a surplus to a deficit region.

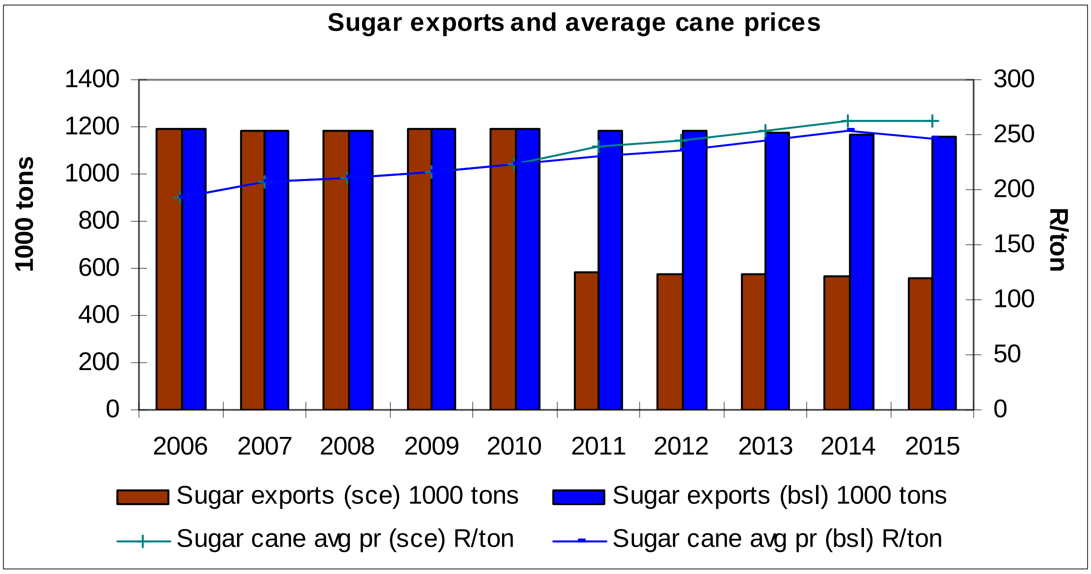

Figure 6: Scenario 1: Sugar exports and average cane prices

5.2.2 Scenario 1: The biodiesel industry

South Africa produces relatively small quantities of oilseeds compared to starch crops. Figure 7 below illustrates what the domestic use of biodiesel will consist of in terms of imports and local biodiesel production.

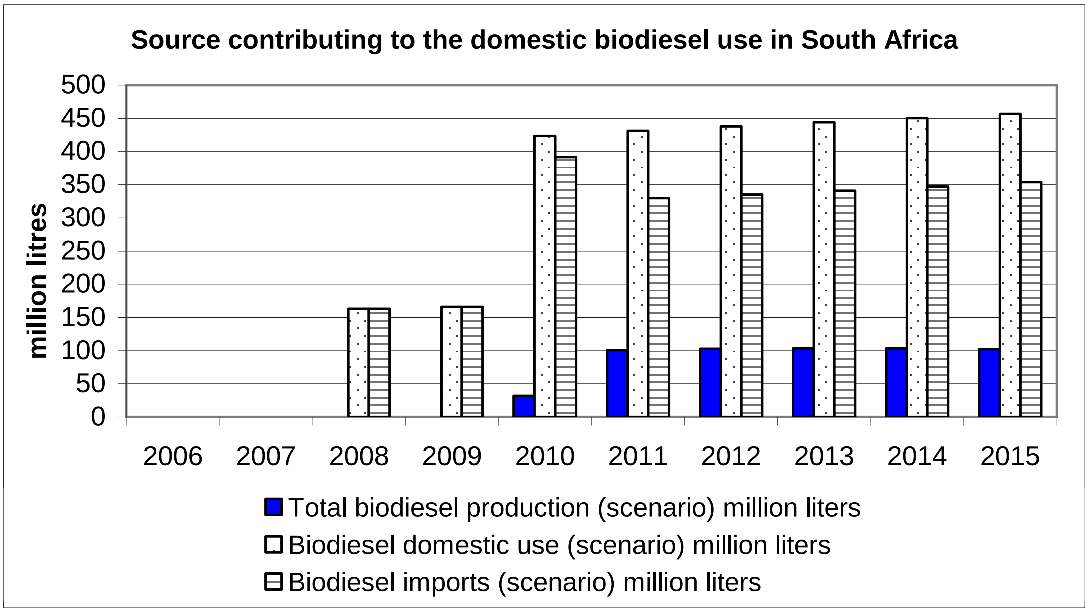

Figure 7: Domestic biodiesel use composition in South Africa

As indicated in Figure 7, imports make up the largest chunk of domestic biodiesel use. These levels of imports decrease as the import tariff of 30% comes into existence in 2011. This again gives the local biodiesel industry a slight boost, but not enough incentive to expand the industry. Only limited production of biodiesel (mostly for on farm use) is projected. The reason for this is that the policies and the incentives are not sufficient to divert vegetable oil away from the human market to the biodiesel market. The biodiesel which is produced in South Africa has its source mainly in soybeans and partly in sunflower seeds after the 2011 tariff introduction.

5.3 Scenario 2: A green but bleak future.

Scenario 2 differs slightly from scenario 1 in that the government implements a mandatory blending policy of E8 and B2 and a fuel levy reduction of 50%. Import tariffs are still not introduced, however. Scenario 2 assumes that the government is under the impression that the industry does not require additional support and decides to abort the fuel levy tax exemption in 2011.

5.3.1 Scenario 2: The ethanol industry

Sugar contributes a relatively constant supply to ethanol production, increasing very slightly from 2011 onwards. From 2012 onwards, when the ethanol mandatory blending requirement comes into full force, both sugar and maize contribute significantly to the mandate. Maize does, however, always contribute more to ethanol production than sugar, although this is not the case in the first scenario where more ethanol is produced from sugar than from maize. The answer lies in the volumes of local production. In the first scenario, just over 900 million litres of ethanol are produced locally, compared to 469 million litres in the second scenario. In the first scenario, an import tariff on ethanol is used to protect the local industry, which makes the production of ethanol very lucrative. The higher level of demand for yellow maize increases yellow maize prices to such an extent that it becomes more profitable to produce ethanol from sugar. In the second scenario, less maize is demanded and prices increase only moderately, which makes the production of ethanol from maize more profitable.

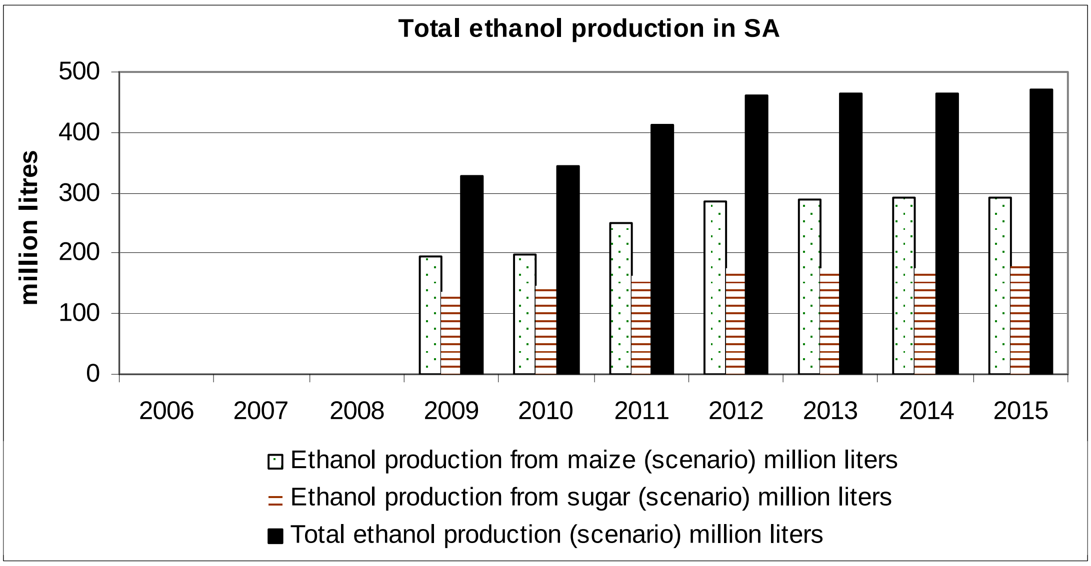

Figure 8: Total ethanol production by crop in SA

As the domestic ethanol industry uses both maize and sugar as a feedstock for ethanol production and since almost half of the ethanol is imported in a refined form, the production of DDG is significantly lower than if most of the ethanol were to be produced from maize. With lower DDG being produced, the price of DDG actually moves closer to the producer price of yellow maize. The production of DDG levels off at around 200 000 tons from 2012 onwards. The white and yellow maize prices are projected to increase by 7% and 11% percent respectively in the long run and the area under maize production is projected to increase by approximately 100 000 ha.

5.3.2 Scenario 2: The biodiesel industry

The situation has not changed significantly from scenario 1. The majority of the biodiesel used in the South African fuel mix is still imported and a mere 40 million litres per annum are produced locally. The imports of biodiesel remain relatively constant, but indicate a slight rise in 2011, when the fuel tax levy is reduced.

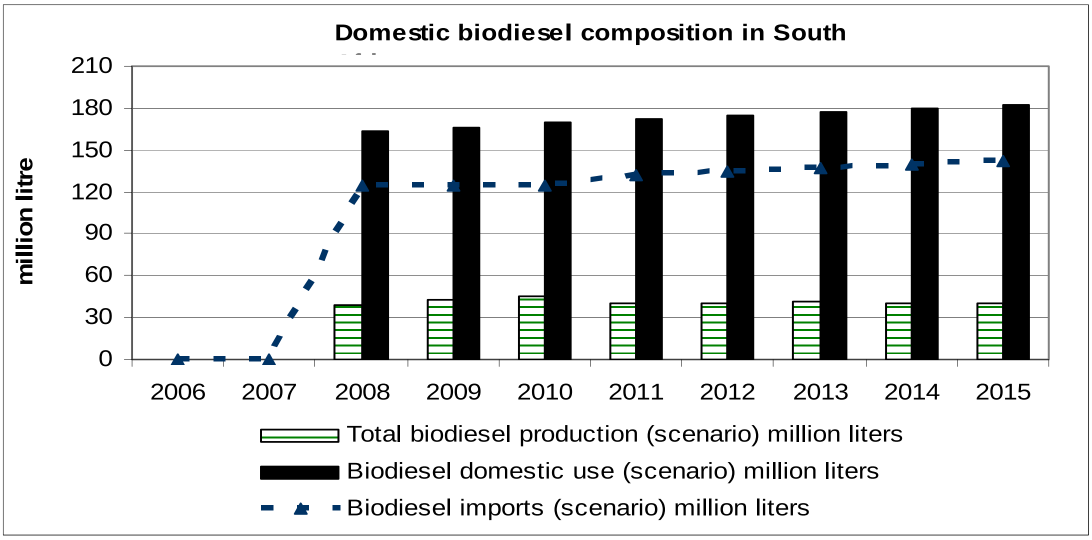

Figure 9: Domestic biodiesel composition in South Africa

Soybean imports and soy cake production increase at the exact same rate from 2007 onwards. Sunflower cake and sunflower oil imports, on the other hand, follow directly opposite trends. The sunflower cake production increases at first and then stays relatively constant.

One major constraint of this exercise is that biodiesel is currently not traded on the world market, unlike ethanol. The model simulates that imports will satisfy the domestic requirements for biodiesel. However, it is uncertain whether this will in fact be a realistic scenario in the future.

6. Concluding remarks

Before the results of this study are summarised, it is important to note that the following factors, which will have a definite impact on the nature of a future South African biofuels industry, were not taken into consideration in this study. These factors are: the locations and size of biofuel plants, the improvement in farming practices to reduce the costs of production, the drastic increase in the yield of commercial field crops, climate change, the development of alternative crops, improved efficiency of the production of biofuels and the development of an alternative market for by-products.

This study shows that a lack of government support of the local biofuels industry can seriously affect its economic viability, especially in the early stages of the industry's development. The model results indicate that the absence of import tariffs for both bioethanol and biodiesel most likely is one of the most important support mechanisms that the government can apply to the industry. In scenario 1 the implementation of a 30% *ad valorem* import tariff boosts the local production of ethanol, in comparison to a scenario in which no tariff is applicable. The fuel levy tax exemption is another important tool that the government can use to support the local industry. In scenario 2 the fuel levy tax exemption mechanism is reduced to zero in 2011 and as a result the local production of biofuels remains stagnant and is unable to expand further. This policy combined with a no import tariff situation can have a negative impact on the potential expansion of this industry.

In many of the now dominant biofuel producing countries, government support, in several possible forms, has played and in most instances is still playing an important role in developing the industry. It is therefore crucial that all potential role-players in this infant industry work towards a common representative and sustainable policy.

Finally, a few critical questions need to be raised when debating the establishment of a biofuels industry in South Africa. No country in the world uses a staple to produce biofuels. Therefore, policy alternatives have to be carefully considered to understand the impact of such an approach on food security, but not without recognising the opportunity to grow the local agricultural sector with higher profit margins. With approximately 1 million tons of maize required for the production of ethanol under a scenario that favours the production of biofuels, the projected increase in maize prices is moderate. However, the probability of the maize market trading at import parity levels if weather conditions are below normal is very high; this would put upward pressure on food prices. Furthermore, the cost of information in the biofuels industry is very high because of the risk and uncertainty inherent in the industry. It is an infant industry and more time is needed to analyse various policy alternatives and to develop a sense of the tradeoffs that accompany different policy packages. Some role-players are already paying the price of uninformed decision-making. The government needs to allow for more time to research the initiative and for policy-makers to find the optimal policy by means of the harmonisation of various policy targets and developmental goals.

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