CHANGES IN AGRICULTURAL INDUSTRIES
BIO FUEL CHAINS – ANALYZING STRUCTURE, OPTIONS, AND IMPACTS

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Abstract

Structural change in the agricultural sector as well as in the whole agricultural value chain is an ongoing dynamic process and affords a number of diverse phenomena. The EU Strategy for Biofuels (2006) and the Biomass action plan (2005) set a clear signal that the EU wishes to establish and to support the bio energy-industry. The perceivable aim of the Common Agricultural Policy (CAP) consists in reducing food production and in enlarging the non-food production. Another driver for the attractiveness of bio-energy and bio-fuel production is the price history of crude oil and natural gas in recent years. As a result the total production of biofuels in the EU is increasing rapidly. The EU`s production of liquid biofuels (bioethanol, biodiesel) amounted to a total of 2.4 Million tonnes in 2004 (EurObserver, 2005); an increase of more than 25 % compared with the previous year. Catalysts have been the adoption of Biofuels Directive (2003/30/EC) by the EU Commission as well as the urge that member states have to ensure that in 2005 biofuels account for at least 2 % of the total used transportation fuels. In 2010 a minimum stake of 5.75 % has to be met. In 2007 German enterprises are planning to enlarge the production capacity for bioethanol production for 330.000 t/a as well as for biodiesel 1.9 Million t/a. For example, on top of the already planned capital expenditures of about € 500 million in bioethanol production the German "Südzucker Group" plans within the next years to triple the production capacity to over one million tonnes in Germany, Austria, Belgium, France and Hungary. This development leads to structural changes in the agricultural sector as well as in the whole agricultural value chain. Beside price increase of commodities the formation of vertically organized structures along the value chain can be observed in order to guarantee on the one hand production efficiency (regional supply of raw material) and on the other hand safeguarding the high investments. The aim of the paper refers to the consequences of the rapid growth of the bio-energy sector and its diverse impacts on all stages along the whole chain and the agricultural sector. As generally pointed out the production is changing from an industry which is dominated by family-based, small-scale, relatively independent firms to one of larger firms that are more tightly aligned across the production and distribution value chain. Hence the aim is to elaborate on the impact of verticalisation as a main consequence on the management of agricultural enterprises. For example, in the value chain of bioethanol there are two types in which both farms are involved. On the one hand there are the central plants which are operated by companies and on the other hand there are the distilleries and cooperative distilleries which are ran by farmers or where they have a close regional connection with. In both types farms are providing the raw material. But the conditions differ between these types. In the first type, farmers account the advantages of companies as operators. The risk is lower and the safety of payments is more ensured than in smaller enterprises. Furthermore farmers can develop long term marketing possibilities. But for big producing sites there is the need of a high amount of raw material so the market power of the single farmer is going down and because of the heterogeneous group of farmers it will remain low. The single farm is replaceable. The smaller amount of suppliers in small producing distilleries makes a straight -and partially participatory- contractual framework necessary. Additionally in this context we will elaborate on the assessment of the implications for farm incomes and the rural economy. Interviews are conducted with the managers of enterprises which produce bioethanol and biodiesel in Germany. The focus will be laid on the vertical institutional structures between agricultural enterprises and the producers of biofuels, especially on embodiment of the formal and informal contracts between farmers and biofuel producers.

Introduction

The EU Strategy for Biofuels (2006), the Biomass action plan (2005) and the adoption of Biofuels Directive (2003/30/EC) by the EU Commission set a clear signal that the EU wishes to establish and to support the bio energy-industry. As a result the total production of bio fuels in the EU is increasing rapidly. In addition, since 2005 bio fuels have to account for at least 2 % of the total used transportation fuels in the EU-member states. Moreover, in 2010 a minimum stake of 5.75 % has to be met. In Germany additionally the introduction of a bio fuel quota ensured that the mineral oil companies – starting at the 01 January 2007 – have to secure that 4.4 % of the sales of diesel are made of bio diesel as well as that 1.2 % (from 2008 2 %, from 2009 2.8 % and from 2010 3.6 %) of the sales of motor fuel are made of bio fuel (Bundestag resolution, 26.10.2006).
Furthermore the perceivable aim of the Common Agricultural Policy (CAP) consists in reducing food production and in favour of enlarges the non-food production. Moreover, further drivers of the attractiveness of bio fuel production are the price history of crude oil and natural gas in recent years, international developments (such as climate change, pressure of environmental NGOs), technological advances and innovations, price development of commodities and substitutes, reduction of risks caused by harmful exhaust emissions and by greenhouse gas emissions, as well as free capacities (obligatory set-aside).
Based on the drafted developments the aim of the paper is to clarify the structure of the biomass-based energy value chain exemplifying the production of bio ethanol and bio diesel. First, we will give an overview of the current sector developments and afterwards the questions “who is the initiator of the biomass-based energy value chain?”, “who coordinates the process of bringing biomass into final energy products?” and “how to organize it?” will be answered.

Bio fuel production, potentials and future investments in the EU and Germany
In 2005 the EU’s production of liquid bio fuels (bio ethanol, bio diesel) amounted to a total of 3.2 million tonnes; an increase of more than 30 % compared with the previous year (FNR, 2007). Whereas bio ethanol totalled for 0.5 million tonnes and bio diesel for 2.7 million tonnes (see figure 1).

Figure 1: Bio fuel production in EU 25 and Germany in tonnes

		2002	2003	2004	2005
Biodiesel	EU 25	1,134,000	1,504,000	1,933,400	2,740,000
	Germany	450,000	715,000	1,035,000	n.s.
Bioethanol	EU 25	388,200	424,750	491,040	500,000
	Germany	n.s.	0	20,000	n.s.
Total	EU 25	1,522,200	1,928,750	2,424,440	3,240,000
	Germany	450,000	715,000	1,055,000	n.s.

Source: EurObserver 2005, European Biodiesel Board (EBB), FNR, 2007.

Figure 1 shows that the German bio fuel production increased rapidly since 2003, especially for bio diesel. Also in 2007 an enlargement of the production capacity of bio diesel for additional 1.9 million tonnes and of bio ethanol for 430,000 tonnes is planned. In order to finance this expansion new resources and financing are taped e.g. the initial public offering of Crop Energies in September 2006 ,Verbio AG in October 2006 and, BKN BioKraftstoff Nord AG in February 2007.

Bio Diesel Production, Capacities, and Potentials In Germany

Comparing the production and the sales of bio diesel in Germany for the last few years shows a balanced relationship. Furthermore, the bio diesel supply and the capacities of the plants are sufficient developed so that the bio fuel quota for diesel is already fulfilled in Germany within the next seven years. In order to

meet the compulsory blending of bio diesel of 7 % in Germany until 2015 a production of 2.4 million t/a bio diesel is demanded (FNR, 2007). Assuming that exclusively the raw material consumption for bio diesel would derive from German raw material (rapeseed) the demand will increase from 4.7 million t/a (2005) to 5.9 million t/a (2015). Therefore by 2015 the share of total agricultural area dedicated to bio diesel production will rise from 11.8 % (2005) to over 15 % (2015) (FNR, 2007). In the last years bio diesel production capacity has already increased continuously (see figure 2). Accordingly an increase in production is anticipated i.e. in 2007 an enlargement of the capacity for additional 1.9 million t.

Figure 2: Bio-diesel production capacities in Germany 1998-2006 (1,000 tonnes/a)

	1999	2000	2001	2002	2003	2004	2005	2006
Production Capacity	175	290	531	874	1,050	1,237	1,197	3,603

Source: FNR, 2007.

In general for bio diesel we find a dual production structure. On the one hand there are smaller oil mills owned by single farmers or farmer bio fuel producing associations and on the other there are larger commercial mills with production capacities over 1,000 t/a. About 50 production facilities have even production capacities between 4,000 and 500,000 t /a (e.g. BKN BioKraftstoff Nord AG with a capacity up to 50,000t/a). Recently we can observe a change towards lager production facilities.

Bio Ethanol Production, Capacities, And Potentials In Germany

In Germany the bio ethanol production from cereals is with 330,000 t/a (2005) at a starting point (FNR, 2007). In 2006 there has been a production capacity of around 640,000 t. Figure 3 shows that the production capacities for bio ethanol in 2007 shall be increased for about 430,000 t. Probably, depending on political future developments (e.g. decisions about tax break) the production capacity of bio ethanol will rise up.

Figure 3: Bio ethanol capacities in Germany in 2006 and 2007 in tonnes/a

Operating Company	Location	Capacity in 2006 in t	planned in 2007	Capacity in 2007 in t
Crop-Energies (Südzucker Group)	Zeitz	260,000	100,000	360,000
Verbio Vereinigte Bioenergie AG (NBE)	Schwedt	230,000		230,000
Verbio Vereinigte Bioenergie AG (MBE)	Zörbig	100,000		100,000
fuel 21 (Nordzucker Group)	Klein Wanzleben		130,000	130,000
Bernhard Icking KG	Seyda	7,500		7,500
WABIO Bioenergie	Bad Köstritz	8,400		8,400
NAWARO Chemie GmbH	Rostock		100,000	100,000
PROKON Nord Energiesysteme GmbH	Stade		100,000	100,000
KWST	Hannover	30,000		30,000
Total		635,900	430,000	1,065,900

Source: own source, FNR, 2007.

The following example demonstrates the dimension of this development. On top of the already planned capital expenditures of about € 500 million in bio ethanol production the German "Südzucker Group" plans within the next years to triple the production capacity to over one million tonnes in Germany, Austria, Belgium, France and Hungary. Hence, the "Südzucker Group" will be the market leader in the EU with a market share of about 10 %. Taking a closer look on the example demonstrates the size of this plan. In Germany at the production location Zeitz 260,000 t/a bio ethanol are produced from 700,000 t of wheat since 2005. In future on the basis of sugar beets additionally 100,000 t/a bio ethanol will be produced. In Belgium "Südzucker AG" plans a bio ethanol production based on wheat and sugar beets with an annual capacity of 300,000 tonnes. Its Austrian affiliate AGRANA started with building a bio ethanol production plant in Pischelsdorf (Lower Austria). As from autumn 2007 it will operate with an annual capacity up to 240,000 t bio ethanol. In Hungary AGRANA already produces annually 50,000 t bio ethanol. It is planned to increase the capacity to 160,000 t/a.

The example shows that due to the economies of size in the production of bio ethanol only large plants are profitable and high investments are needed. However, one factor that complicates the investments is that the tax break for bio ethanol only lasts until 2008. Between 2008 and 2012 the decision about a tax over compensation will be annually based on a new report. This aspect as well as the uncertainty about the development of the price of crude oil makes investments in large plants unsure. In addition the deferred WTO-Negotiations with MERCOSUR and the uncertainty about the import protection for bio ethanol are problems for investors. The WTO suggestions provide a reduction of the import protection for ethanol by 40 %. In this case the production would be no longer competitive in the EU.

Mainly due to political pressure a significant increase of the production of bio fuels can be expected. Thus, we assume that the supply for raw materials for the bio fuel production in Germany and in the EU 25 will increase alike. Reasons for this prognosis are stagnating food-prices and simultaneously increasing yields. Additionally, the demand of land area for the increase of raw material for bio fuels can be made available without difficulties. For example, until 2010 more than 2.5 million ha agricultural crop land and until 2020 more than 5 million ha will be released from food production in Germany (Zeddies, 2006). Moreover the production of bio ethanol requires less land than of bio diesel, due to larger bio fuel yield per hectare from the crops-potential feedstock for bio ethanol (Kavalov, 2004). In respect to this aspect the potentials should be differentiate in bio diesel and bio ethanol production.

Organisation of the Relations in the Value Chain

After outlining the structure of the bio fuel sector and the recent developments we want to address in the following paragraphs the questions about "who is the initiator of the biomass-based energy value chain?", "who coordinates the process of bringing biomass into final energy products?" and "how to organize it?". Therefore, we sketch the organization of value chains in general and afterwards apply the knowledge on an example.

Chain Organization

Value chains can be characterised as the collaborative interaction of independent enterprises (Brito and Roseira, 2005; Boehlje, 1999; Goerzen and Beamish, 2005). In agriculture most often they are supply chain networks. They are pyramidal-hierarchical structured so that they dispose over a focal company (Lazzarini et al., 2001). In the context of the organization of value chains on the one hand arising conflicts of individual interests must be managed and on the other hand interdependent actions of the actors must be coordinated (Gulati et al., 2005). Gulati (1998) emphasised that collaborations must be analysed not only from the perspective of the involved firms and the dyadic level of interaction but also out of an overall perspective. In the context of chain management, Duysters et al. (2004) named them firm level, dyadic level, and network level. Hanf/Dautzenberg (2006) combined these aspects in a general framework

of chain management. Although research on collaborations focuses on the interrelationships between firms, still single enterprises have to be regarded as the initial elements.

Thus, in this paper we want to pay particular attention on the firm level. Even though it may sound self-evident we consider the willingness of the firms and the involved people to cooperate as the necessary prerequisite. Because cooperation demands that enterprises adjust their own actions with the ones of their partners, on the firm level general cooperativeness means that the enterprises have to be willing to abstain from some of their managerial freedom. Thus firms have to recognise collaborations as a means to overcome limitations of their resources. If a firm is participating in collaborations, it faces additional tasks and added work. Thus collaboration consumes resources of the firms e.g. time restraints of the managers and employees have to be reallocated. Therefore managing collaboration on the firm level demands particular managerial skills as well as resources (Duysters and Heimeriks, 2002; Dyer and Singh, 1998; Kale et al., 2002; Zaheer and Bell, 2005).

Initiator and Focal Companies Of Value Chains

We pointed out that the initiation of the biomass-based energy value chain is a result of the EU Policy (EU Strategy for Bio fuels (2006), Biomass action plan (2005) and the concrete implementation in the resolution of 26 October 2006 in Germany). The key role for the embodiment and realisation of the process of bringing biomass into final energy products usually take the processor of bio fuels so that they can be considered to be the focal companies.

Case Study "Crop Energies"

The processor Crop Energies (Südzucker Group) located in Zeitz (bio ethanol manufacturing plants for 260,000 t/a) has long-term contracts with agricultural enterprises in Germany to cover the grain supply. The main reason for using contracts is to safeguard their high investment costs. Actually, Crop Energies offers via local co-operatives or wholesalers contracts to local farmers. These contracts contain a price premium for protein poor bio ethanol-wheat a particular breed for energy production. Therewith, for the first time wheat with protein content less than 12 % receives a price premium (dlz 9/2006). The specific amount is not defined yet but it seems an interesting perspective for farmers. Backgrounds for this decision are different requirements for bio ethanol and food production. Whereas for food production usually wheat with high protein content and low starch content is necessary wheat for bio ethanol production needs high starch content combined with low protein content to ensure high crop of bio ethanol.

In 2007 on the source of sugar beets Crop Energies will produce additionally 100,000 tonnes/a bio ethanol in Zeitz. On account of this about 600,000 tonnes of sugar beets are required for the supply for the bio ethanol plant every year. The decision about the investment in the new bio ethanol production plant has been dependent on the fact, that at least 80 % of the required sugar beets are produced under binding contracts with a term of 5 years. To supply bio ethanol beets farmers face the prerequisite that they have to subscribe the delivering right E. The delivering right E is a joint project of about 25,000 sugar beet farmers (SZVG, 2006). Having such a high number of farmers the total amount of the investment is divided upon them in order to share the risk. The amount of subscription of the delivering right E consists of fixed and variable components. The variable rate is coupled with the prices for bio ethanol. On the one hand the farmers get additions capital in rising markets and on the other hand in falling markets they will discharged. The fixed rate constitutes the own capital contribution of the farmer. The delivering right is also delivery commitment up to 2011. In 2006 farmers all over south Germany signed up production contracts. According to the association "Süddeutscher Zuckerrübenanbauer e.V." and the regional associations the chances and risks were divided between farmers and "Südzucker" due to the fluctuating ethanol prices. Therefore the prices of bio ethanol beets will vary according to the changing ethanol prices. The price trend for ethanol is increasing on all markets, the world market price is also increasing

with 0.26 €/l in 2005. For Europe the actually import protection is € 0.192/l (Bayerische Landesanstalt für Landwirtschaft). Due to the great demand for bio ethanol beets on the part of the farmers every farmer is allowed to signed up for a maximum of 14,4 % of unabridged contract amount of sugar beets. Another important fact is the possibility of transfer the delivering rights for farmers until 2008.

The above mentioned example of Crop Energies exemplifies the opportunity for farm enterprises to specialize in new markets. Even though the income risk is shared on both partners - due to the rather short-term nature of the contracts - investments into technology and training on side of the farmers can be regarded as risky. Because of this farmers might have only a limited cooperativeness. On the other hand the subscription of the delivering right safeguards the access to new production potentials. In the case of bio ethanol production the initiator is the processor, while only large plant production is profitable. Farmers have the opportunity to decide to invest in this new market with moderate risk. On the one hand production process knowledge about e.g. new breeds and cultivation and on the other hand knowledge about cooperation problems and developments of new markets are essential requirements.

Conclusions

Opportunities and Threats for Farmers and Processors

Farmers as well as producers can benefit from advantages but have to face also the flip side of the coin. The usage of contracts could be an advantage for farmers. They lower their income risks because they receive an ex ante defined price which is bound to defined qualities and quantities. But contracts have also a drawback because they bear the threat of dependencies. In the case of bio fuel production however this threat is not enormous because the production of bio-energy crops is at first sight not very different from the production of crops for food purposes. The common technology like machinery can be used as well as an akin production system with moderate adoptions. Minor differences will occur by getting optimal composition of input factors such as fertilizer and agro-chemicals. For instance, the above mentioned quality for wheat is no longer defined by high protein content (which can be achieved by additional nitrogen application) quite contrary low protein grains are demanded. Further advantage will arise to farmers in the different treatment of the commodity when the crop is no longer considered as food rather it is non-food. The benefit arises from lower standards for non food commodities. Especially this applies to transportation and storage. However, due to this development farmers face also danger. The non-food commodity will be transformed within progress in breeding and processing for its optimal use so that it is no more transferable for food-use which means that an alternative marketing is not possible. Thus, farmers get in a lock-in situation and their scope for tactical manoeuvre is narrowed, at least for short-term decisions.

For processors the main motivations for integration in the value chain is to acquire secure supply i.e. they are interested to get a fixed demand with defined qualities and to reduce transportation costs. The example of Crop Energies demonstrates that processors find a way to get farmers actively involved in the supply chain. Processors, e.g. Choren are convinced that biomass supply will be scarce on the international market in medium term. In this case transportation costs will predominantly determine the price of biomass. Therefore bio fuel production will be profitable if processors can secure most of their biomass from local area.

Summary

The described changes in the biomass-based energy sector and the arising structures of vertical organized value chains raise a number of challenging issues. The main drivers for increasing future prospects for bio-energy in Europe are the Biofuels Directive (2003/30/EC) and the EU Strategy for Bio fuels (2006).

In total the EU's production of liquid bio fuels amounted to a total of 3.2 million tonnes in 2005 which is an increase of more than 30 % compared with the previous year. Because solely in 2007 German enterprises are planning to enlarge the production capacity for bio ethanol production for 430,000 t/a as well as for bio diesel 1.9 million t/a we predict that the growth will continue. Because of this we discussed the emerging value chain organization and management requirements first in general and afterwards we applied it to a case study on bio ethanol production. Due to the chain's characteristics in particular large companies such as the German Südzucker AG can be regarded as the initiator of these chains. In order to safeguard their high initial investments and to secure efficient supply these companies are relying rather on contract farming than on spot market interactions. On one hand the determination of the production by long-term contracts can lead to a restriction of the liberties of the farmers. On the other hand the integration in supply chains is becoming increasingly important and it will be essential for farmers to identify strategies for becoming compatible with such systems.

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