

THE UTILIZATION OF RAPESEED FOR BIOFUELS PRODUCTION IN THE EU

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Biofuels production has risen rapidly in the past decade. Growing tendency can be expected in the future if national governments will continue in achievement of higher share of 'green energy'. Diversification and self-sufficiency in energy and environmental aspects should underpin national and international policy. Consumption of biofuels in the transport sector has been significantly increasing since 2000. Biofuels produced in the EU are mostly first-generation biofuels, mainly produced from agricultural raw materials. The aim of the article is utilization assessment of the main agriculture crop used in biofuels production in the EU, which is rapeseed. For achievement of the research objective have been used analysis methods, basic statistical indices, the share of rapeseed production used in industrial purposes estimation and self – sufficiency index. The results of the research confirm authors' expectations concerning shifting of agricultural production primarily intended for food and feed production to industrial purposes due to continually growing demand for biofuels.

Keywords: biofuels, biodiesel, rapeseed, self-sufficiency

Introduction

Biofuels are a good alternative to fossil fuels in the transport system compared to other technologies because the technologies for biofuels production are already well developed and are available in many countries (Doering, 2005).

Biodiesel and bioethanol belong to the biofuels, representing the majority of liquid biofuels consumption in transport sector. Bioethanol and biodiesel are generally produced from agricultural crops valued more than half of biofuels production cost (Mitchell, 2005).

Production and consumption of bioethanol perform the largest share in the world liquid biofuels market. Bioethanol is produced from crops containing starch and sugar (corn, sugar beet, sugar cane, wheat). Production and consumption of biodiesel perform the largest share in European liquid biofuels market and is mainly produced from oilseed, animal fats and recycled cooking oil.

Resources and inputs materials for biodiesel production

Vegetable oils belong to the renewable materials that are currently used also for the production of biodiesel. Production of biodiesel by transesterification of vegetable oils is currently the primary source of biodiesel.

The most widely used input material for biodiesel production in the EU is rapeseed oil made from rapeseed, which accounts for the production of biodiesel in the range of 57–70%.

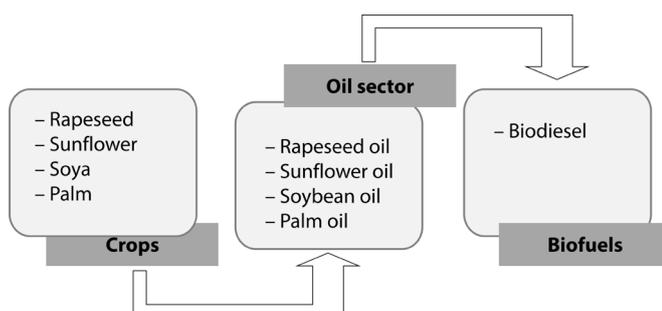


Figure 1 Resources and input materials for biodiesel production
Source: own processing

In the European Union, 77% of biodiesel production is produced from rapeseed oil. Other important materials involved in the production of biodiesel are soybean oil and palm oil, which are mostly imported into Europe. The shares of soybean oil and palm oil in the production of biodiesel in the EU are 9% and 12%, respectively. The rest of the production of biodiesel coming from waste materials is estimated to make 2% (USDA, 2010).

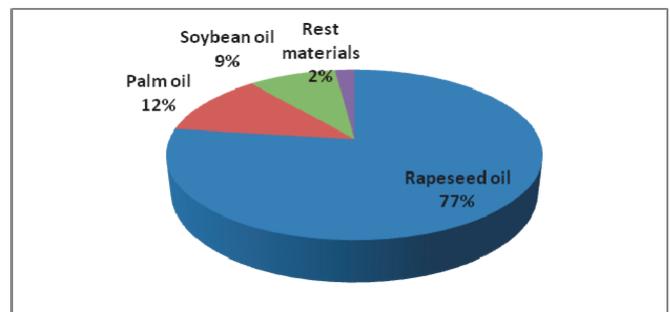


Figure 2 Structure of input materials used for biodiesel production in the EU
Source: USDA 2010, own processing

Significantly increased demand for crops used for biofuels lead to pressure on food supplies, especially for cereals and vegetable oils, thus contributing to the growth and volatility of food prices. On the one hand, using crops for food and biofuel production represents a huge opportunity for the location of production, but on the other hand, it also represents a threat to food security (Woods et al., 2010).

Objectives and methodology

The aim of the article is to assess production and consumption of the main agriculture commodity for biofuels production purposes. The main crop for biofuels production in condition of the European Union is rapeseed. In the article we focused on rapeseed analysis, which consist from following parts:

The balance of production and supply of rapeseed in the EU

The balance is performed by analyzing the development of basic production characteristics of rapeseed and evaluation of development and structure of

the total supply of rapeseed in the distribution of production, imports and stocks.

Self-sufficiency in the production of rapeseed in the EU

The self-sufficiency index (SSR) shows the relationship between the production of agricultural commodities and their domestic consumption. Self – sufficiency index expresses the rate of satisfaction of domestic consumption by production.

The estimation of production and area for growing rapeseed for biodiesel production in the EU

The estimation of rapeseed used for industrial processing (biodiesel) is performed by quantifying the amount of rapeseed used for industrial purposes. Convergence coefficient ($\beta = 0.4$) (Thuijl et al., 2003) was used for calculation of the quantity of rapeseed for biodiesel production, indicating the yield rapeseed to canola oil.

Estimated production of rapeseed for biodiesel is extended by quantification of land area used for growing rapeseed for biodiesel production by means of yields per hectare. Quantification of acreage and production is carried out at the EU level. The aim is to determine the trend in the field and assess the changes in orientation of the use of crops for energy purposes.

Results

The balance of production and consumption of rapeseed in the EU

Oilseeds are important sources of energy in food and feed. They also represent a significant source for biofuels. One of the most profitable species grown in temperate climates is rape. Seeds of plants provide material for the production of oil suitable for food and industrial use.

Due to the reduction in the amounts of fossil fuels ever-increasing standards of living and consumption of goods and energy production, rapeseed has become a promising material for energy production. The plant is an important raw material for processing in various fields of industry, especially for diesel engines. Scope of rapeseed use is mostly dependent on the production costs, the organization of local resources, and on the use and adaptation of the technological aspects of trade, drying and storage.

Increasing consumption of rapeseed is supported by the EU policy, which regulates the blending methyl ester of rapeseed oil in diesel. It can influence the gap between the consumer world reserves and global consumption of commodities. Rapeseed is used for the production of food and non-food oils (biodiesel) and animal feed. Significant increase in oilseed production has been marked since 2003, while the EU directive implemented this year

established the obligation to blending bio-fuels. Increased production of rapeseed is significantly affected by rising demand for biofuels.

The production of rapeseed in the EU in the analyzed period increased significantly. In the period of 2000–2010, the production of rape increased by 68%. As represents the table 1, the base and chain indices, and the highest increase in rapeseed production was observed in 2004. That year, the production of oilseed rape compared to the previous year 2003 increased by 38%. In 2009, rapeseed production exceeded 21 million tons in the EU. However, since 2009 the production of rapeseed slightly decreased.

A global leader in the growing of rapeseed is the EU-27. Acreage of rapeseed in the EU-27 reached almost 7 million hectares. The best natural conditions for growing rapeseed provides mild climate. The countries of southern Europe (Portugal, Greece, Cyprus and Malta) do not have suitable conditions for the cultivation of rapeseed. Other southern EU countries (Spain, Italy and Bulgaria) create less than 10% of rapeseed production in the EU.

The biggest producer of rapeseed in the EU is Germany; the share in 2010 was 30% of the total production of rapeseed. The second biggest producer of rapeseed is France (26%), followed by Poland (12%), the UK (9%) and the Czech Republic (5%).

The total supply of rapeseed includes production, imports and stocks. The main source of supply of oilseed rape is domestic production, the share of the total supply during the period 2000 to 2005 ranged on average at about 95%. Since 2005, we observe a slight decline in the share of domestic production to the total supply of rape due to an increase in rape import. Since then, the average share of domestic production to total supply of canola is around 85%.

The most significant change in the structure of the overall supply of rapeseed in the EU occurred in 2008. In this year, we observe a significant increase in imports of rapeseed. Development of rapeseed foreign trade is presented by the following figure.

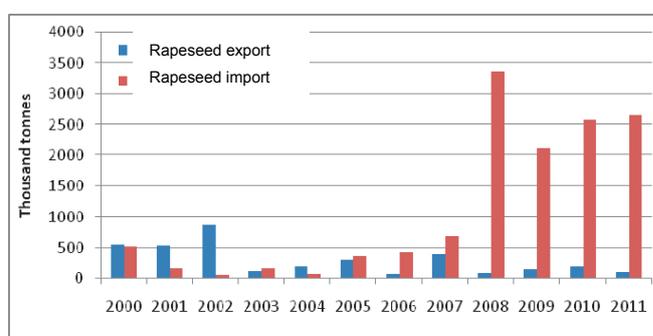


Figure 3 Development of rapeseed foreign trade in the EU
Source: USDA own processing

Table 1 Development of rapeseed production in EU-27

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Production in thousand t	11 364	11 585	11 752	11 185	15 432	15 523	16 092	18 358	19 000	21 551	20 706	19 100
Base- index	100%	101.9	103.4	98.4	135.8	136.6	141.6	161.5	167.2	189.6	182.2	168.1
Chain- index	x	101.9	101.4	95.2	138.0	100.6	103.7	114.1	103.5	113.4	96.1	92.2
Acreage in thousand ha	4 124	4 159	4 270	4 198	4 572	4 846	5 408	6 554	6 182	6 516	6 985	6 750
Base- index	100%	100.8	103.5	101.8	110.9	117.5	131.1	158.9	149.9	158.0	169.4	163.7
Chain- index	x	100.8	102.7	98.3	108.9	106.0	111.6	121.2	94.3	105.4	107.2	96.6
Yields per hectare in t.ha	2.76	2.79	2.75	2.66	3.38	3.20	2.98	2.80	3.07	3.31	2.96	2.83

Source: USDA, own processing

Table 2 Development and structure of total rapeseed supply in the EU

Year	Total supply in thousand tonnes	Domestic production in thousand tonnes	Share of production on total supply in %	Rapeseed import in thousand tonnes	Share of import on total supply in %	Rapeseed stock in thousand tonnes
2000	12 330	11 364	92.2	518	4.2	448
2001	12 238	11 585	94.7	168	1.4	485
2002	12 440	11 752	94.5	55	0.4	633
2003	11 687	11 185	95.7	168	1.4	334
2004	15 780	15 432	97.8	70	0.4	278
2005	17 592	15 523	88.2	378	2.1	1 691
2006	18 124	16 092	88.8	432	2.4	1 600
2007	20 486	18 358	89.6	687	3.4	1 441
2008	23 314	19 000	81.5	3 355	14.4	959
2009	25 500	21 551	84.5	2 106	8.3	1 843
2010	25 087	20 706	82.5	2 572	10.3	1 809
2011	23 490	19 100	81.3	2 650	11.3	1 740

Source: USDA, own processing

Self-sufficiency in the production of rapeseed

The growing importance of international trade is also reflected in an increase in the volume of agricultural commodities flows. It is important to determine to what extent we are able to satisfy domestic consumption by own resources. Index of self-sufficiency (SSR), indicating the ratio between the production of agricultural commodities and domestic consumption, shows the rate of satisfaction of domestic consumption by production.

In general, if the self-sufficiency index is around 1, the country is self-sufficient in consumption of the commodity. Until 2005, self-sufficiency index of rapeseed reached values equal or greater than 1. The exception was the year 2003, when the self-sufficiency index was 0.99 – that value was reached due to unfavourable weather conditions and subsequent poor harvests. During this period, till 2005, the surplus was exported from the EU.

From 2005 on, the situation in development of self-sufficiency of rapeseed has changed. Due to the increasing production of biofuels there is increasing demand for the raw material. The increasing demand for oilseed rape has been a driving force for building a large production capacity for biodiesel. Creating opportunities and capabilities for processing crops for industrial purposes and policy support for biofuels has caused the demand for oilseed rape growing faster than its production.

The impact of biofuels production on rapeseed market is confirmed by the development of self-sufficiency ratios, which have been decreasing since 2005, which means that the consumption of rapeseed in the EU is not self-sufficient, and satisfying the domestic consumption is covered by imports from non-member countries.

Estimated production and consumption of rapeseed for biodiesel production in the EU

Biofuels production affects the use of input materials. As a result of the expansion of biofuels production, new placement opportunities in agricultural production occur, representing new sources of income for farmers, and bringing many other benefits from environmental point of view, and due to the reduction of dependence on imported fossil fuels.

On the other hand, there are conflicts between the use of agricultural crops for food use and for industrial purposes. It is important to analyse the rate of increasing consumed amount of biofuel crops and determine shift towards the use of agricultural crops for industrial purposes at the expense of food purpose.

The main purpose of using rapeseed oil for industrial purposes is production of biodiesel, which has become a driving force in production and

Table 3 Consumption and self-sufficiency in the production of rapeseed in the EU

	Production of Rapeseed in thousand t	Domestic consumption in thousand t	Self – sufficiency index
2000	11 364	11 288	1.01
2001	11 585	11 060	1.05
2002	11 752	11 240	1.05
2003	11 185	11 288	0.99
2004	15 432	13 890	1.11
2005	15 523	15 693	0.99
2006	16 092	16 608	0.97
2007	18 358	19 129	0.96
2008	19 000	21 374	0.89
2009	21 551	23 534	0.92
2010	20 706	23 150	0.89

Source: USDA, own processing

Table 4 The amount used for the production of canola rapeseed oil for industrial purposes

	2003	2004	2005	2006	2007	2008	2009	2010	2010**
Consumption of rapeseed oil for industrial purpose in thousand t	1 783	2 588	3 709	4 768	4 919	5 931	7 190	6 905	7 562
The convergence coefficient ($\beta=0.4$)*	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Quantity of rapeseed used for industrial purpose in thousand t	4 458	6 470	9 273	11 920	12 298	14 828	17 975	17 263	18 906
Land acreage for rapeseed growing for industrial purposes in thousand hectares	1 673	1 917	2 895	4 006	4 390	4 824	5 435	5 823	6 387
Share of rapeseed used in industry on total rapeseed supply in %	38.1	41.0	52.7	65.8	60.0	63.6	70.5	68.8	–

* the convergence coefficient $\beta = 0.4$, gives the rapeseed yield; ** impact assessment of achievement the target (5.75%) for the production and acreage of oilseed rape
Source: Own processing

consumption of their inputs material in recent years. The intensive biofuels production began in 2003, after the adoption of the European Directive, which sets targets for renewable energy as well as the increase in the share of total consumption of bio-fuels in the EU. This fact is a key determinant affecting changes in the use of rapeseed.

Rape is a crop that has become more 'independent' on the original commodity processing (food and feed) in recent years and has been gradually changing into a crop with significant industrial use (biodiesel). As the previous table 4 presents, the shares of rapeseed production for industrial purposes from the total production of rapeseed in 2003 ranged from 15% to 40%. The rest of rapeseed production was used for its primary purpose, which is food processing.

Since 2003, the purpose of rapeseed utilization has been changing, as is confirmed by the results from the estimation shares of rape for industrial use from the total EU production of rapeseed. We observe a growing trend of using rapeseed produced for industrial purposes. In 2010, the domestic consumption of rapeseed oil for industrial use contributes to 68.8% of the total supply of rapeseed in the EU. Change in the structure of rapeseed use occurs, which is subject to the production of biofuels, in addition to causing changes in production, foreign trade and changes in land grab.

As the chart indicates, land suitable for growing rapeseed for industrial purposes during the period 2000–2010 varies considerably. Significant change in this case is attributed to the production of biofuels, which affects not only land use for industrial purposes as compared to the use of food crops, but it also leads to an increase in the total sown area of crops, which reinforces position of oilseeds in sowing structure.

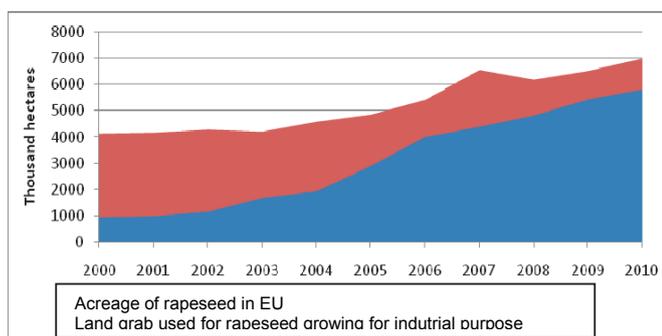


Figure 4 Development of acreage of land used for rapeseed growing in the EU
Source: USDA, own processing

Discussion and Conclusion

According to Serra (2009), rapeseed has become more 'independent' on the original commodity processing (food and feed) in recent years and gradually has been changing into a crop with significant industrial use (biodiesel). This claim is consistent with the results achieved in the paper.

Change in the use of rapeseed has occurred since 2003. This year, the EU Biofuels Directive (2003/30/EC) implemented and set targets for biofuels. Shares of rapeseed production for industrial purposes on the total rapeseed production until 2003 ranged from 15% to 40%. The rest of produced rapeseed was used for its primary purpose, which is food and feed processing.

The results of the research indicate that increasing production of biodiesel leads to an increase in production and acreage of rapeseed as an input for biodiesel production. Production of biodiesel represents new opportunities for farmers for the placement of their production. The growth of biodiesel production also leads to changes in orientation of rapeseed consumption and utilization.

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