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CURRENT PROSPECTS OF BIODIESEL PRODUCTION IN UKRAINE

Abstract: The current state of petroleum fuel providing for Ukraine in the conditions of foreign monopoly sources is analyzed and perspectives of European experience application in the sphere of biodiesel production are considered. The comparative analysis of rapeseed production parameters (used rape cultivation area, average yield and gross) in the EU and Ukraine is conducted in the time dynamics. The correlation between the rapeseeds and diesel prices in Europe is defined. The growth of export potential of rapeseed in Ukraine is expected with the current reduction of production. Two variants for rapeseed market development in Ukraine are considered: domestically oriented with the need of infrastructure formation for oil and biodiesel production and export-oriented, economically more profitable in the short term planning. The cost components of rapeseed production and economic feasibility in Ukraine are analyzed in time dynamic and regional grouping. The main accent is made on the Western Ukraine (Ivano-Frankivsk, Lviv and Ternopil regions). The strong correlation between the values of rapeseed production volumes and its crop area is found for Ivano-Frankivsk and Lviv regions (extensive type of farming). The analysis of capabilities for meeting farmers of Ivano-Frankivsk region needs with diesel fuel by processing rapeseed has been carried out and model of possible rapeseed gross harvesting is presented. Improving rapeseed cultivation and local processing in the current geopolitical conditions is strategically important. At the same time, complete replacement of traditional diesel fuel in Ukraine by biodiesel is unreal but step-by-step increasing of rapeseed oil production has a strategic economic feasibility in the long term perspective.

Keywords: biodiesel, rapeseed, cost components, average yield and gross, production.

JEL Classification: O13, P32

Introduction

Energy independence is one of the key challenges facing Ukraine, and ignoring this issue is a global destabilizing factor, which can cause economic decline and thus national security threat.

From the view point of traditional types of primary energy availability for Ukraine the share of imported primary energy was 51.2% in 2015 (Energy balance of Ukraine, 2015, available from: http://www.ukrstat.gov.ua/operativ/operativ2016/energ/en_bal/Bal_2015_u.zip), which corresponds to the average European situation: 54.1% was for the EU 28 in 2015 (Eurostat, 2015 available from: <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tsdcc310>). However, if we take into account only petrol and diesel fuel from the energy balance, the import share reached 85% in 2015.

Ukraine imported 7.413 million tonnes of petroleum products worth USD 3.267 billion in 2016. Most oil products were imported from Belarus (USD 1794 milion), Russia (USD 542.755 milion), Lithuania (USD 354 milion), and other countries up to USD 576 million. The high price of imported fuel is a negative factor for price setting at domestic and foreign markets. Also imported fuel causes a slowdown of the economy due to lack of domestic production and therefore lack of demand for professionals.

There is a strong dependence on foreign monopoly oil sources. Possible diminution in diesel fuel supply from Belarus and Russia (> 70% of total imports), which is a threat to the transport sector, agricultural sector and the military, is extremely topical. The main means of neutralizing these threats is to diversify both sources and routes for oil and energy technologies. It will linger geopolitical risks connected with the monopoly of supplier and create competition as a powerful factor in reducing costs for energy resources procurement. European experience has shown the possibility for significant reducing energy dependence by growing and processing oilseeds for biodiesel. This will not completely solve problems of availability of petroleum in transport sphere, but will smooth them out in some sectors, particularly in agriculture.

Despite significant progress in this area, the problem of meeting local needs of biodiesel for consumers and agricultural producers of Ukraine, particularly its western region, requires detailed consideration and study.

The purpose of the article

The article aims to study the current state in the production of rapeseed in the EU and Ukraine and outline prospects for biofuels production by integrated agricultural enterprises in Ukraine based on the analysis of this issue in the EU.

Research results

Today in Europe there are long-term trends in the overall optimization and reduction of energy consumption, diversifying their supply markets

and increasing the proportion of energy derived from renewable sources. For the EU28 average share of biofuels in the transport sector was 6.7% in 2015, for Poland it was 6.4% (Eurostat, available from: <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc340&plugin=1>). The total production of biodiesel in Europe is 11 million TOE, Poland share is 0.82 million TOE (Fig. 1).

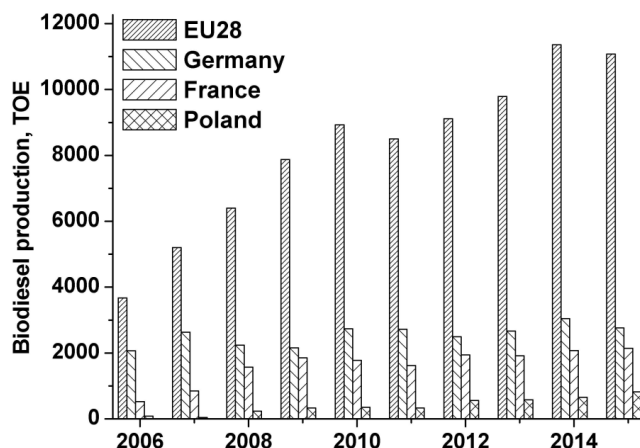


Figure 1. Dynamics of changes of biodiesel production in the EU

Source: Eurostat reports

The area under rapeseed cultivation in Europe covers about 6,487,000 hectares (Fig. 2). The main European producers of rape are Germany (1.334 million hectares), France (1.512 million hectares) and Poland (0.821 million hectares). Maximum acreage for this crop in Europe was observed in 2011-2012, after that decline was rather low; generally there is stabilization of this indicator over time. In Germany, usually 10-12% of the total arable land is given for rapeseed crops. In France, which has a structure of land resources similar to Ukraine, the relative area of rape crop is 8-10%. This figure corresponds to the characteristics of Ukraine: the percentage of arable land occupied by rape crops was 12.9, 10.5 and 8.2% in 2013, 2014 and 2015, respectively.

The average yield for the major producers is about centner/ha, in particular for Germany, France and Poland it was 34.6, 30.57 and 28 centner/ha in 2016, although whole season could be called unfavourable for crops. Gross rapeseed reached the maximum value (about 24 million tonnes) in 2014, for the next two seasons there was a decline in this indicator (Fig. 2), which was less than 20 million tonnes in 2016.

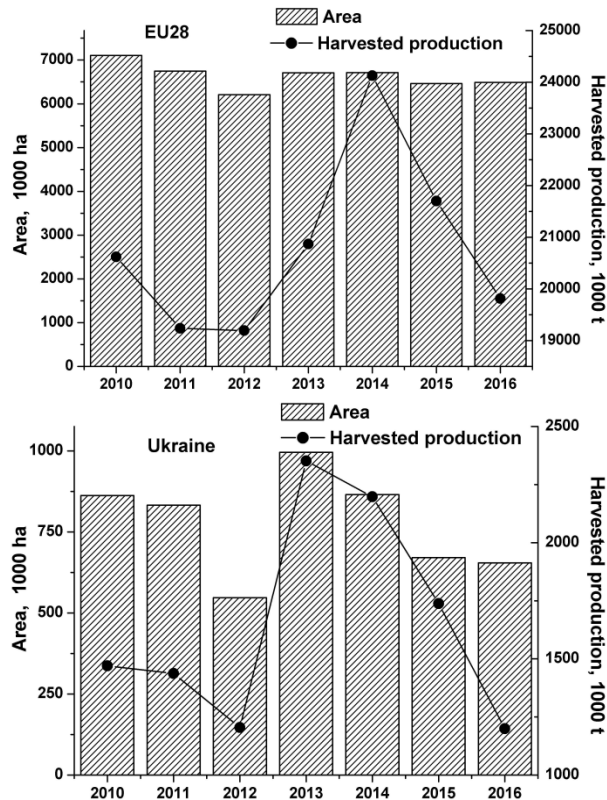


Figure 2. Dynamics of changes in acreage and gross harvest of rape for the EU and Ukraine in 2010-2016

Source: Formed by the author based at data of State Statistics service of Ukraine, Eurostat reports and reports of the Cabinet of Ministers of Ukraine

However, according to the European Commission, the 2017/18 season will be more successful for the EU in rapeseed producing. European domestic rapeseed crop could increase to 22,130,000 tonnes (20 million tonnes in the 2016/17 season) due to favourable weather conditions and by expanding the area under this crop sowing to 6620 thousand ha (compared to 6493 thousand ha in the season of 2016/2017). Thus, Ukrainian producers will be faced with lower demand for rapeseed in EU.

In Ukraine, there is negative dynamics of rapeseed production for the last three years. The decline in 2016 compared with the peak in 2013 is about 49%. This situation is the result of several factors: reduced acreage, unfavourable weather conditions, loss of winter oilseed rape, which, due to significantly higher (39% in 2015) completely dominates (97% in 2015) for sowing areas. In particular, the share of the acreage on which rape was dead during wintering in 2013, 2014, 2015 and 2016 amounted to 6, 9, 25 and 25-40% (according to various estimates), respectively.

In the season of 2016-2017 sprouts of winter rape from sown of 899.2 thousand ha were received in the area of 833.1 thousand ha (93% of the sown), from which 684.0 thousand ha (82%) are in good and satisfactory condition, and 147.7 thousand ha (18%) are weak and liquefied. Compared to the season 2015/2016, we can expect growth of rape gross harvest on 54%, i.e. returning to the level of 2015.

As for the cost of rapeseeds in Europe during the period 2010-2015, it reached a peak in 2012 (EUR 473 / t) followed by a decline during 2013-2014 to 315 EUR / t in 2014, due to a sharp rise of production. Reduced production in 2015-2016 (Fig. 3) has led to the restoration of positive trends in pricing, in 2016 the average price increased to EUR 398 / t.

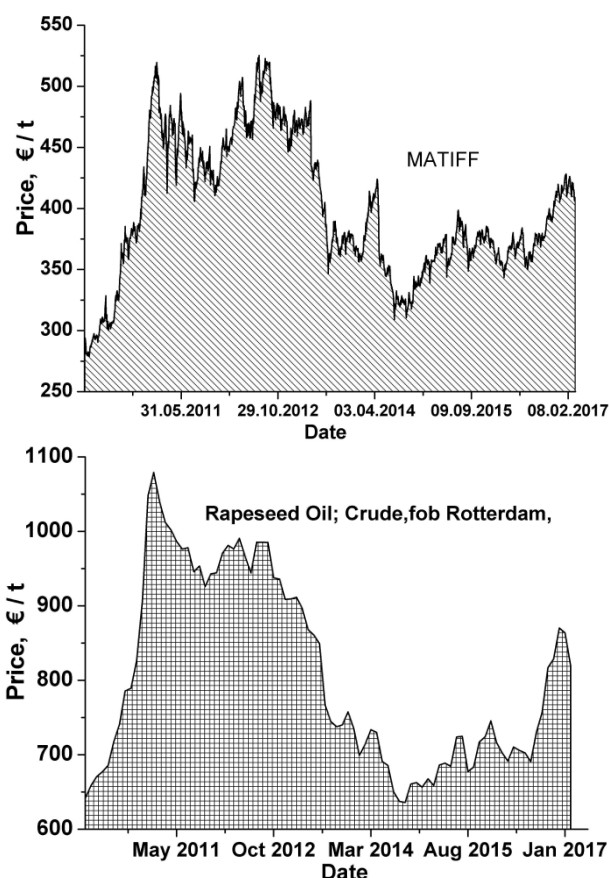


Figure 3. Dynamics of changes in the price of rapeseed and crude rapeseed oil

Source: Statistic reports available at:

<http://www.indexmundi.com/commodities/?commodity=rapeseed-oil&months=120¤cy=eur> and

https://www.zmp.de/en/exchanges/matif/matif-rapeseed_future

According to the analysts of Matif corporation prices for rapeseeds will be stabilized and some reduction in prices can be expected in the near future (Figure 4).

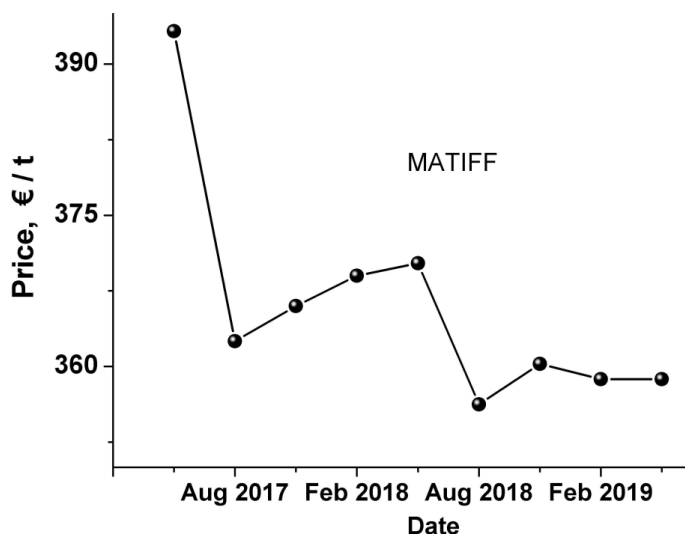


Figure 4: **Forecast for rapeseed prices in 2017-2019**

Source: Statistic reports available at:

https://www.zmp.de/en/exchanges/matif/matif-rapeseed_future

During the period of 2010-2014 there was a correlation between the price of rapeseed and average price of diesel fuel (Fig. 5), but since 2015 against the recession and the reduction in oil prices there was a growth of prices for raw materials for biodiesel.

EU keeps rapeseed processing volumes at the level of 24-26 million tonnes / year; while gross yield of about 20-22 million tonnes provides imports of raw materials.

The maximum level of exports of rapeseed in the EU countries was observed in 2016 (about 3.8 million), with the values of 3.49, 2.36 and 3.49 million tonnes in 2013, 2014 and 2015, respectively.

According to Eurostat forecasts, imports of rapeseed in the EU will reach 3.46 million tonnes in 2017 (EU market: oilseeds, oilseed meals & vegetable oils supply & demand, 2017, Available from: http://ec.europa.eu/agriculture/sites/agriculture/files/cereals/balance-sheets/oilseeds/overview_en.pdf).

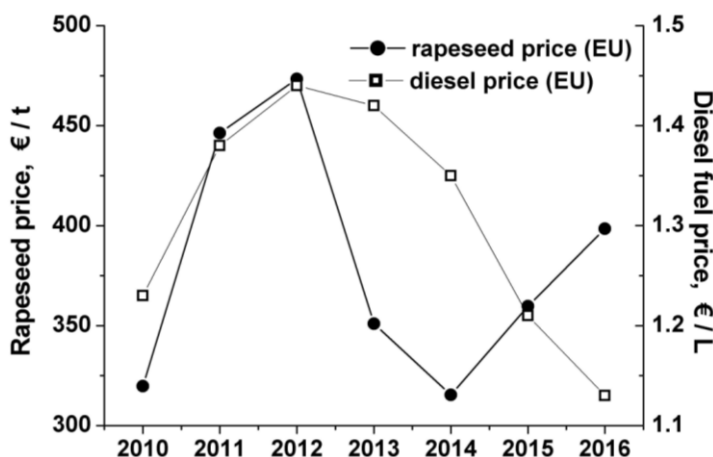


Figure 5. Dynamics of changes of average prices of rapeseed and diesel fuel in the EU during 2010-2014

Source: Eurostat reports

The main suppliers of rapeseed in the EU are Ukraine, Canada and Australia. However, the EU leads the ranking of the main producers of rape (21.6 million tonnes in 2016), whereas Canada has 14.3 million tonnes, China 14.1 million tonnes, India 7.2 million tons, Australia 3.3 million tons. According to “Europe 2020: Sustainable Development and Climate Change Challenges for the future” (Available from: http://www.bernardmazijn.be/fileadmin/pdf/europe2020_bernardmazijn.pdf), it is expected to achieve the proportion of biofuels in the transport sector at 10%. Realization of this goal requires imports up to 25-30% of required feedstock for generation of biofuel.

Thus, we can expect growth of export potential of rapeseed produced in Ukraine. However, in 2016 there was a decrease of rapeseed exports by 30.7% compared to 2015 (994 and 1435 thousand tonnes respectively). The major importers of Ukrainian rapeseed in 2016 were the EU countries: France (USD 84.65 million), Poland (USD 73.08 million) and Germany (USD 65.87 million), which exported 214.4, 185.1 and 166.8 thousand tonnes of raw materials, respectively. Also in 2015 significant amount of rapeseed was exported to Pakistan (422 thousand tonnes) and the UAE (110 thousand tonnes).

As for internal processing of rapeseed with obtaining oil and feed products, the positive trends of the 2015 season were levelled in 2016 (Fig. 6).

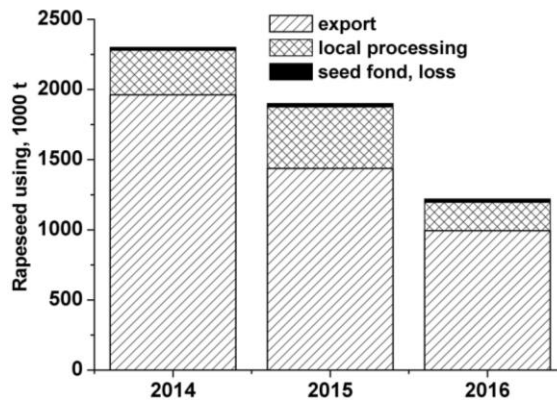


Figure 6: **Dynamics produced rapeseed use in 2014-2016 in Ukraine**

Source: In 2016/17 the geography of rapeseed export from Ukraine narrowed, 2017, available from:

<http://www.proagro.com.ua/news/ukr/12641.html>

If in 2014 and 2015 production volumes of rapeseed oil were 94 and 148 thousand tonnes, respectively, in 2016 a decline is observed, in particular according to the results of September-February 2016/17 production declined by 67.5% and in January-February 2017 by 81%. An additional factor that will determine this reduction, along with a reduction in acreage of crops, is massive export of rapeseed, which is not subject to export duties. From the 2016 harvest as of 03.01.2017 more than 950 thousand tonnes of rapeseed (86% of the gross harvest) has been exported and sent for recycling about 10% of the gross yield.

According to the report (Profitability of soy and rape continue to grow, 2016) in Ukraine in the near future upward trend in the profitability of export-oriented production of rape will continue, in particular 53, 2% in 2016 compared to 44.3% in 2015 and 29.2% in 2014. For comparison, the profitability of sunflower production, which in recent years has shown a steady growth (8.8% in 2012, 28.5% in 2013, 36.5% in 2014, and 80.5% in 2015), was reduced to 63.5% in 2016, but it is possible only for agro-climatic conditions of eastern and southern parts of Ukraine.

There are two variants for rapeseed market development in Ukraine: domestically oriented with the need of infrastructure formation for oil and biodiesel production and export-oriented one. At present, the second option is economically expedient in the short term. However, current trends in the energy sector require diversification of fuel sources with simultaneous localization of production, creation of new jobs and obtaining additional costs. It necessitates economic assessments of rape processing efficiency in domestic facilities.

Let us consider the cost components of rapeseed production and its economic feasibility. Direct material costs on average in Ukraine are

about 71.7% of total costs. The value of seeds and planting material is 10.3% of material costs, mineral fertilizers - 33.3%, fuels and lubricants - 15.2, payment to other organizations - 14.3, the remaining material costs - 26.9, labour costs - 3.9%. For other direct costs and overhead expenses (21.8% of total costs), their structure is formed by amortization of fixed assets (23.4%), social contributions (6.4%) and other expenses (70.2%). The cost of fertilizers and payment to organizations dominate among the direct material costs of production, they vary in the different regions with similar percentage cost structure formation (Table 1).

Table1. Profitability of rape growing in the regions of Ukraine

Profitability, %			
	2014	2015	Changes in relation to 2015
Ukraine	29.2	44.3	51.7
Vinnysia Oblast	22.4	51.7	130.8
Volyn Oblast	46.1	46.1	0.0
Dnipropetrovsk Oblast	32.7	61.7	88.7
Donetsk Oblast	-	79.7	-
Zhytomyr Oblast	18.1	43.3	139.2
Zakarpattia Oblast	44.6	76.8	72.2
Zaporizhia Oblast	20	61.9	209.5
Ivano-Frankivsk Oblast	26.2	38.3	46.2
Kirovohrad Oblast	45.4	47.8	5.3
Kiev Oblast	35.3	69.6	97.2
Luhansk Oblast	98.2	105.9	7.8
Lviv Oblast	19.7	25.7	30.5
Mykolaiv Oblast	40.1	41.4	3.2
Odessa Oblast	40.3	50.6	25.6
Poltava Oblast	6.8	58.4	758.8
Rivne Oblast	-	40.4	-
Sumy Oblast	10.1	11.3	11.9
Ternopil Oblast	32.5	58.6	80.3
Kharkiv Oblast	25.5	44.1	72.9
Kherson Oblast	19.7	56.3	185.8
Khmelnyskyi Oblast	34.2	53.3	55.8
Cherkasy Oblast	36.8	49.9	35.6
Chernivtsi Oblast	-	24.2	-
Chernihiv Oblast	12.5	-43.4	-447.2

Source: State Statistics service of Ukraine

Arguably, rape is a highly profitable crop for most regions of Ukraine and its profitability is rising against the background of the decrease in production resulting from both objective factors and market conditions. Favourable conditions for growing rapeseed are in Vinnytsia, Zhytomyr, Ivano-Frankivsk, Kyiv, Lviv, Volyn and other regions.

During 2010-2014, for the analyzed regions (Ivano-Frankivsk, Lviv and Ternopil Oblast) there was a growth of crops volume and production (Fig. 7), which was slightly changed in 2015. Despite this, overall rapeseed production was 370 thousand tonnes. For Ivano-Frankivsk region the figure is about 59 thousand tonnes, about 27 thousand hectares of arable land were involved.

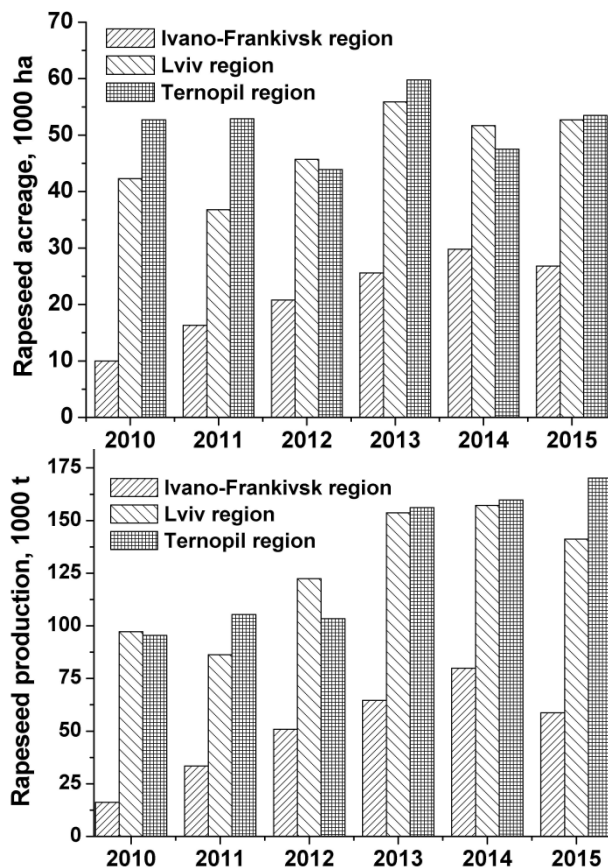


Figure 7. Dynamics of rapeseed production and involved acreage in Ivano-Frankivsk, Lviv and Ternopil regions during 2010-2015

Source: Statistical Yearbook "Agriculture in Ukraine" from 2015, available from: <http://agroua.net/statistics/>

Statistical analysis revealed that for number of regions, including Ivano-Frankivsk and Lviv, there is a strong correlation between the values

of rapeseed production volumes and its crop area (Fig. 8). However, in the Ternopil region such correlation has not been found.

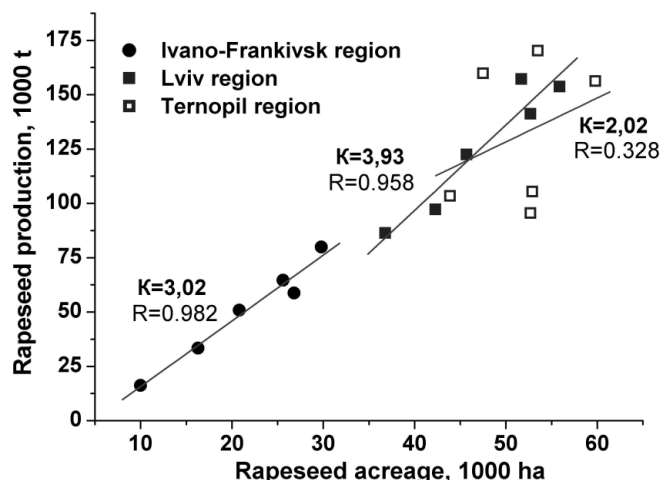


Figure 8. The correlation between values of rapeseed production volumes and its crop area in Ivano-Frankivsk, Ternopil and Lviv regions during 2010-2015

Source: Statistical Yearbook "Agriculture in Ukraine" from 2015, available from: <http://agroua.net/statistics/>

This result provides the possibility of reliable statistical estimates of potential to increase acreage for these areas aimed at enlarging rapeseed production volumes.

Analysis of capabilities for meeting farmers of Ivano-Frankivsk region needs with diesel fuel by processing rapeseed has been carried out. Total consumption of diesel fuel in Ivano-Frankivsk, Lviv and Ternopil regions of Ukraine for the period 2011-2015 shows a decline of about 20% while keeping the share in national consumption at the level of 10.5-12.5%. To assess the annual demand in diesel fuel the amount of 600 thousand tonnes has been taken.

Model for definition of rapeseed gross harvest (sufficient to meet the needs of Ivano-Frankivsk in diesel fuel and necessary for this acreage) includes the following statements:

- 1) oil content of rape was set equal to 35% (real oil content of researched crop is 38 - 50% according to the type, but after the extraction it is about 7-10% of oil);
- 2) output of rape-methyl ester from rapeseed oil is 90% (real technological output is about 95-96%, but there are technical losses);
- 3) the relative content of rapeseed methyl ester in biofuel mixture is 75%;

4) the amount of rape-methyl ester, needed to prepare biofuel, exceeds the mass of diesel oil in 15% (a consequence of the difference in the heat of combustion).

Thus, to replace 75% of annual demand in diesel fuel 450 thousand tonnes are needed, and taking into account the calorific value correction - 517.5 thousand tonnes of rapeseed-methyl ether. It is necessary to recycle 575 thousand tonnes of rapeseed oil, which involves the use of about 1,640 tonnes of rapeseed.

The average yield of rapeseed in Ukraine was 25.9 centner/ha in 2015. However, for areas of Western Ukraine the figure was 21.9, 26.8 and 31.8 centner/ha for Ivano-Frankivsk, Lviv and Ternopil regions, respectively, but for the Ivano-Frankivsk region unfavourable agronomic conditions should be considered. For calculations the yield index 25 centner/ha is used, as a real value (rapeseed is able to provide stable yields of 20-25 centner/ha annually, assuming that the average yield of sunflower is 10-12 centner/ha). Thus, for such volumes of crops the use of about 657 thousand ha of arable land is required. This value is comparable with the general volume of acreage of Ivano-Frankivsk region, where land fund as of 2014 amounted to 1392.7 thousand ha, including 645.4 thousand ha (46.4%) occupied by farmland (Socio-economic analysis of Ivano-Frankivsk region, 2014, available from <http://www.if.gov.ua/files/2004.06.2014.pdf>). The share of rape crops was about 4% of agricultural land. Given the need for five-field crop rotation, Ivano-Frankivsk commissioning 50% of unused agricultural lands can provide about 20% of the required volume of diesel fuel using locally grown rapeseed.

Conclusion

1. Comparative analysis of the rapeseed production, applied acreage and prices of rapeseed and diesel fuel in the EU and Ukraine suggests that the rape growing is highly profitable for Ukrainian producers and this trend will continue in the near future.

2. The improving of rapeseed cultivation in Ukraine (particularly its western region) in the current geopolitical conditions is strategically important. Current export orientation of rapeseed production is stimulated by EU strategy of eco-fuels consumption. Rapeseed local processing with additional revenue and state-level support has the potential economic benefits of job creation, multiplicative effects in related industries, reducing human impact on the environment, animal feed production, and generation of biogas.

3. The main problems in the production of biodiesel in Ukraine are legal (lack of regulatory frameworks, system of state subsidies and tax incentives to biodiesel producers, forming conditions for foreign invest-

ments attracting, establishing mandatory content of biodiesel in fuel) and economic (the implementation of export duties on rapeseed and benefits for oil exporter, providing a stable resource base, forming on the basis of existing oil-processing factories additional integrated infrastructure, the establishment of guaranteed state purchases of rapeseed oil in futures mode).

4. Complete replacement of traditional diesel fuel in Western Ukraine by biodiesel is unreal at the current oil prices but local rapeseed processing has a strategic economic feasibility in the long term perspective, especially for farmers.

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