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RELATIVE EFFICIENCY OF OILSEED CROPS PRODUCTION IN THE SELECTED FARMS IN EUROPE AND THE WORLD IN 2005

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Abstract. The article contains an analysis of production efficiency of oilseed crops in selected farms associated in International Farm Comparison Network (IFCN). Mt RE (Metric tonne Rapeseed Equivalent) is used for the purpose of comparison of oilseed crops production efficiency. Technical efficiency was computed by applying Data Envelopment Analysis (DEA). Analysis of efficiency shows that products of soya and sunflower can rival products of rape.

Key words: DEA, production efficiency, oilseed rape, soya, sunflower

INTRODUCTION

In year 2006 in Poland from about 600 thousand hectares of fields oilseed rape was harvested. The amount of collected crops was about 1,7 million tons. In connection with the European Union directives considering the biocomponents in fuel, the demand for oilseed rape will increase about 1,1 million tons till year 2010. It is compliant with the actual agricultural policy which guarantees stabilized requirements on farm products used on non-food processing purposes. According to the GUS (Main Statistical Office) data, the demands for biocomponents will increase from 90,95 thousand m^3 in year 2006, to 348,92 thousand m^3 in year 2010. The relation between prices of wheat and oilseed rape becomes more favourable. These facts mentioned above, encourage farmers to plant more oilseed rape.

An alternative, which will be helpful to satisfy demand for the growing interest in oilseed plants, can be an import of these plants from other countries. The aim of the article is to show the difference of efficiency in cultivation of oilseed plants in chosen farms, which are located in Europe and other parts of the world.

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MATERIALS AND METHODS

The research was conducted in 26 farms from Europe and rest part of the world, where oilseed plants were cultivated. The farms are taking part in IFCN – International Farm Comparison Network. The data was achieved from surveys and it includes year 2005. The list of farms, standard information and oilseed plants cultivated in these farms are presented in Figure 1. Names of particular farms, are sorted according to the following schema: the first two letters stand for the country (location), number presented in the name show the approximate farm area in ha, and the last two letters stand for it's localization (region or geographically). Also the names of farms were sorted according to the plants which are cultivated in these farms.

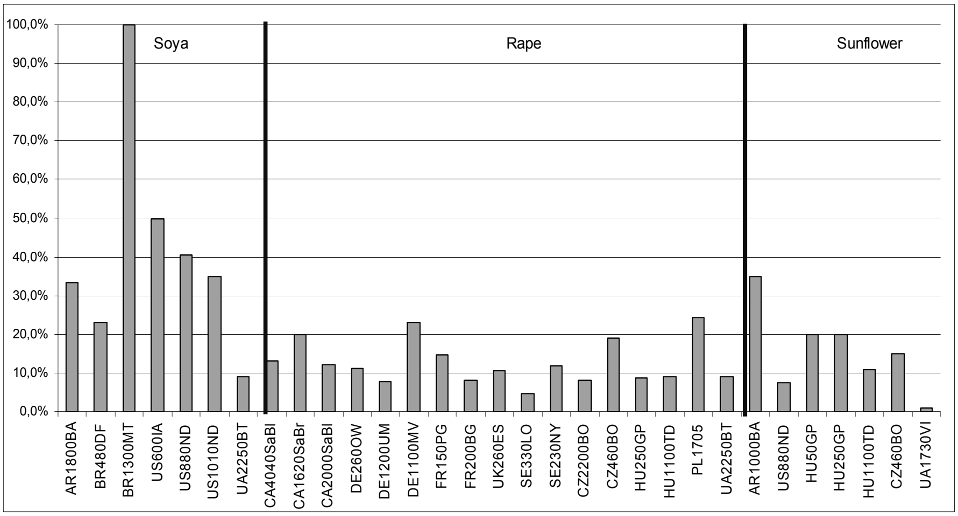

Fig. 1. Percentage of oilseed crops in total crops planted in year 2005
Rys. 1. Procentowy udział roślin oleistych na nasiona w ogólnej powierzchni zasiewów w 2005 roku
Source: Own calculation based on IFCN data.
Źródło: Opracowanie własne na podstawie danych IFCN.

In order to show the difference in production efficiency of particular oilseed plants, an EPV (Estimated Processed Value) factor had been created. On its basis, a correction factor was calculated for each plant [Plessmann 2004]. The calculations were made according to the following formula:

$$EPV = Pm \cdot Wm + Po \cdot Wo$$

where:
Pm – price of flour from current seed,
Wm – the percentage of flour in current seed,
Po – price of oil from current seed,
Wo – the percentage of oil in current seed.

The prices which were used for calculations, were accepted as the average prices form ports in the North Sea (according to years 2001–2005). The percentage of particular elements was based on their sharing in other seeds. To calculate the correction factor for each plant, it was stated that for the oilseed rape it is 1,000 and for the rest of plants it was calculated adequately to the value of counted EVP factor. The correction factors which were summarized and are presented in the Table 1.

Table 1. Correction factors
Tabela 1. Wskaźniki korekcyjne

Plant	Oilseed rape	Soya	Sunflower
Correction factor	1.000	0.861	1.034

Source: Own calculation based on IFCN data.
Źródło: Opracowanie własne na podstawie danych IFCN.

Basing on the achieved factors, the real crops were corrected according to the particular plants. As a result, the data was recalculated to MtRE (Metric tonne Rapeseed Equivalent), what allowed to show the difference in production cost, income etc.

In order to compare production efficiency, specific data were used (fixed cost, direct cost, labour cost, financial cost, cost of buildings and machines, land cost, sale income and donations).

Incomes and costs for each farm in year 2005 are presented in Figure 2.

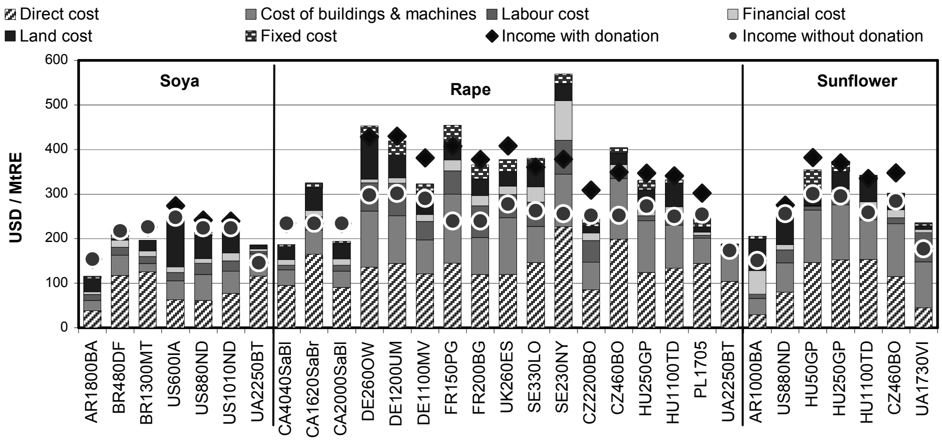

Fig. 2. Incomes and costs for each farm in 2005
Rys. 2. Przychody i koszty w analizowanych gospodarstwach w 2005 roku
Source: Own calculation based on IFCN data.
Źródło: Opracowanie własne na podstawie danych IFCN.

To count the technical efficiency, DEA (Data Envelopment Analysis) was used. This method is based on linear programming and allows to calculate the relative efficiency factor, which in the linear programming task is the aim function, maximizing each object. The final task of dual linear programming, looks like below (the detailed model description can be looked up in [Coelli 1998]):

$$\min_{\Theta,\lambda} \Theta, \text{ with limitations: } \begin{array}{l} Y\lambda \geq Y_o, \\ \Theta X_o - X\lambda \geq 0, \\ \lambda \geq 0. \end{array}$$

where:
X_o – input vector of current object;
X – input matrix of all objects;
Y_o – effect vector of current object;
Y – effect matrix of all objects;
$\lambda_1,...,\lambda_\sigma$ – linear combination factor;
Θ – object efficiency factor.

The aim of optimization this model is to find the minimal Θ value, by which it is possible to reduce the included input or resources by achieving the same effect. If such value cannot be found, then Θ = 1, what means that a more suitable combination is not possible by using the resources and input, and the object can be found as effective. If Θ < 1 means that such combination exists. Information about the optimal combination structure of input and effects, are taken from the calculated factor of linear combination λ. For counting purposes, DEAP 2.1 program was used.

On research purposes, a model which includes changing effects in production scale was created. This was because, the investigated farms were very different in size.

To calculate the efficiency, following factors were taken into consideration:

Effect – sale income ($USD \times MtRE^{-1}$) or sale income + donation ($USD \times MtRE^{-1}$),

Cost – fixed cost, direct cost, labour cost, financial cost, cost of buildings and machines, land cost ($USD \times MtRE^{-1}$).

RESULTS

To calculate the efficiency, two variable variants were made, which were different in accepted to the model effect. First variant covered the income of farm for Metric tonne Rapeseed Equivalent, where the second included additional subvention and donations connected with production of oilseed crops. For all farms a technical efficiency factor was calculated, which in the linear programming task is the function which can be affected with maximizing each object. Decision variables, are scales for particular inputs and effects, however, their values are empirical magnitude. The received efficiency factor is a relative factor, what means, it determines the efficiency of particular in contrast to the rest. As an effect of the optimization, apart from the efficiency factors, an optimal combination of input for each farm which were said to be inefficient was achieved. On account of the size of this case study, optimal combination will not be published, however, received optimal efficiency factors for each farms will be shown (Table 2).

Table 2. Technical efficiency factors for each farm in 2005
Tabela 2. Wskaźniki efektywności technicznej analizowanych gospodarstw w 2005 roku

Farm	Model with donation	Model without donation	Farm	Model with donation	Model without donation
AR1800BA	1,000	1,000	SE330LO	0,920	0,737
BR480DF	1,000	1,000	SE230NY	0,921	0,559
BR1300MT	1,000	1,000	CZ2200BO	1,000	1,000
US600IA	1,000	1,000	CZ460BO	1,000	0,823
US880ND	1,000	1,000	HU250GP	0,997	0,953
US1010ND	0,905	0,908	HU1100TD	1,000	0,718
UA2250BT	1,000	1,000	PL1705	1,000	1,000
CA4040SaBl	1,000	1,000	UA2250BT	1,000	1,000
CA1620SaBr	0,640	0,702	AR1000BA	1,000	1,000
CA2000SaBl	0,980	1,000	US880ND	0,996	1,000
DE260OW	1,000	1,000	HU50GP	1,000	1,000
DE1200UM	1,000	1,000	HU250GP	1,000	1,000
DE1100MV	1,000	1,000	HU1100TD	1,000	0,823
FR150PG	0,907	0,575	CZ460BO	1,000	1,000
FR200BG	1,000	0,662	UA1730VI	1,000	1,000
UK260ES	1,000	0,908	Average	0,976	0,915

Source: Own calculation based on IFCN data.
Źródło: Opracowanie własne na podstawie danych IFCN.

CONCLUSIONS

The research presents that in year 2005 in farms with donation model, 23 were assumed to be efficient, on the other hand, 8 were inefficient. The average efficiency factor was 0,975, where the lowest efficiency factor was 0,640 and it was noted in CA1620SaBr farm. In case of the model without donations, 20 farms were noted to be efficient and 11 inefficient. Average efficiency factor was 0.915, where the lowest efficiency factor was 0.559 and was found in SE230NY farm. Graphical differences in both models are presented on Figure 3.

The analysis of efficiency factors shows that soya and sunflower can compete with oilseed rape. It is clearly seen in the models without donations.

As far as it goes about soya and sunflowers, only one farm was inefficient. Five farms producing oilseed rape were inefficient with model with donation, however in the model without donation 9 farms were inefficient (what makes about 50% of all farms cultivating oilseed rape).

Donations have great influence on production efficiency. In case without donations, 22 from 31 analyzed farms were noticing higher level of costs than incomes, but with including the donations, only 12.

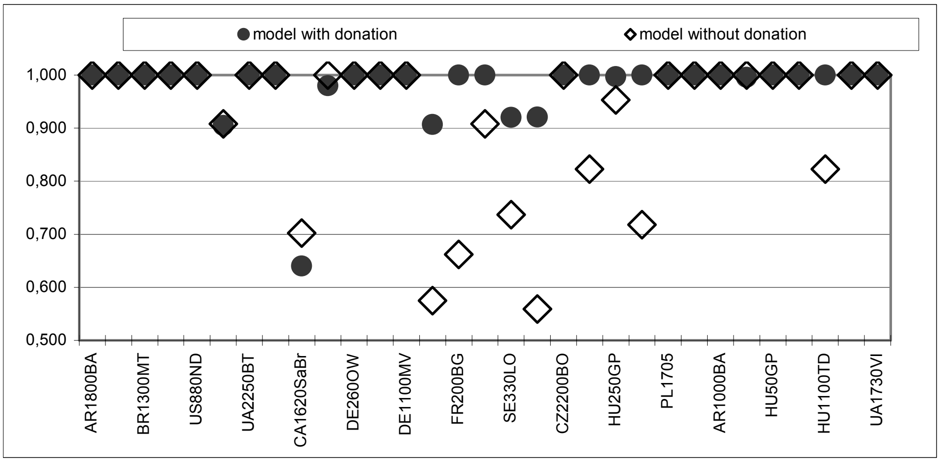

Fig. 3. Comparison of efficiency factors in analyzed farms, including different models in year 2005

Rys. 3. Porównanie wskaźników efektywności w analizowanych gospodarstwach przy różnych modelach w 2005 roku

Source: Own calculation based on IFCN data.

Źródło: Opracowanie własne na podstawie danych IFCN.

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EFEKTYWNOŚĆ WZGLĘDNA PRODUKCJI ROŚLIN OLEISTYCH W WYBRANYCH GOSPODARSTWACH W EUROPIE I NA ŚWIECIE W 2005 ROKU

Streszczenie. W artykule podjęto próbę przedstawienia efektywności produkcji różnych roślin oleistych w wybranych gospodarstwach z Europy zrzeszonych w międzynarodowej sieci gospodarstw porównawczych IFCN. W celu porównania efektywności zarówno przychody, jak i koszty zostały sprowadzone do wspólnej jednostki MtRE (Metric tonne Rapeseed Equivalent), a następnie przy wykorzystaniu metody DEA (Data Envelopment Analysis) obliczono efektywność poszczególnych upraw. Analiza efektywności wykazała, że produkcja soi oraz słonecznika może konkurować z produkcją rzepaku.

Słowa kluczowe: DEA, efektywność produkcji, rzepak, soja, słonecznik

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