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ASSESSMENT OF THE ECONOMIC EFFICIENCY OF THE AGRICULTURAL EXPLOITATIONS THAT HAVE RECEIVED FUNDS THROUGH NPRD, II PILLAR OF CAP, MEASURE 121, 2007-2013, AT THE LEVEL OF THE SOUTH-MUNTENIA REGION

Aurelia BRÎNARU, Ion DONA

University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti, District 1, 11464, Bucharest, Romania, Phone: +40213182564, Fax:+40213182888,
Emails: aureelia_brinaru@yahoo.com, ion_dona@yahoo.com

Corresponding author: aureelia_brinaru@yahoo.com

Abstract

The implications of accessing the European funds related to NPRD 2007-2013, on the agricultural exploitations performances was emphasized by the assessment conducted at the level of nine case studies (agricultural exploitations from the South-Muntenia Region) of the economic and financial efficiency and of the technical efficiency, in the post-project period, comparative with the year of submission of the funding requests. The conducted analysis emphasized the pressure put on accessing the investment funds on the general activity of the agricultural exploitations, and especially on the financial performances, most of the agricultural exploitations taken as case studies experimenting a decrease of the financial profitability. Also, it was emphasized a decrease of the technical efficiency (of the capacity to transform the inputs in outputs), of the exploitation activities and of the general activity, especially in large exploitations. The key method of analysis, used for these studies, was the method of data envelopment analysis (Data Envelopment Analysis - DEA) which was often used in assessing the efficiency of agricultural exploitations.

Key words: *agricultural holdings, DEA method, economic efficiency, scale efficiency,NPDR Pillar II, Romanian agriculture*

INTRODUCTION

The need to have an analysis of the economic efficiency of the agricultural exploitations that have received funds through Pillar II, for the period 2007-2013, became obvious along with the need of reporting by the communitarian authorities of the situation concerning the absorption of the funds taken from foreign sources. It is a series of specific methods for measuring the efficiency, as shall be mentioned bellow, but for saving reasons in the research, we chose the nonparametric model of the data envelopment analysis – DEA, which was often used in assessing the efficiency of the agricultural exploitations. The results obtained this way were and are used in adjusting the financing sources, through Pillar II, offering for authorities those key information required for a good adjustment of the financial system.

MATERIALS AND METHODS

The need to measure the economies' performance or the firms' efficiency and, especially, the measurement of the production factors' productivity, determined the development in the last decades of some specific methods for measuring the efficiency. In time, in addition to the econometric methods and models of analysis, there were also development nonparametric models, like the data envelopment analysis – DEA, which was often used in assessing the agricultural exploitations (Gorton&Davidova, 2004) [6]; Lambarraa et al., 2007 [8]; Krisciukaitiene et al., 2014 [7]; Baležentis et. al.,2014 [3]; Špička&Smutka, 2014 [9]; Atici& Podinovski, 2015 [2] etc.).
The DEA method was created starting from the idea that "the technical efficiency... reflects the ability of a company to obtain the maximum output from a given set of inputs"

[5]. This can be defined as follows: "a model of mathematical programming for data observation, ensuring a new path to obtain empirical estimations of the extreme relationships, like the production functions and/or the areas of the production possibilities, efficient, representing the cornerstone of the modern economy" [4].

The DEA method can be applied by models:

-CRS (constant return to scale) (model CCR) [4];

-VRS (variable return to scale) (model BCC) [4].

Also, the DEA method implies also two approaches: analysis oriented towards input (identification of the input quantities that can be reduced without modifying the produced output quantity) and the analysis oriented towards output (identifying the quantities where the outputs can be increased without affecting the used input quantities). The method shall compare each exploitation (DMU) with the most efficiency agricultural exploitation (DMU).

Due to our objective to measure the performance of the agricultural exploitations under the conditions of accessing the European funds, we used the orientation towards the output, our main objective being to measure the efficiency under the hypothesis that a DMU (an agricultural exploitation) can increase its results and efficiency by using the same inputs.

The DEA method shall follow this way the identification within some DMY (agricultural exploitations) of which operate to an optimal scale, respectively, presenting the potential for increasing the outputs with the actual combination of inputs. In our endeavour we applied the DEA method at the level of year 2008 (year of submitting the projects) and at the level of year 2014, being aimed the identification of:

-The efficiency of incomes from exploitation (Ve) under the current conditions of using expenses with raw materials and materials (Cm), of the expenses with the foreign services (Ce) of the staff expenses (C);

-Efficiency of the total incomes (Vt) under the current conditions of using the agricultural lands (S), intangible assets (A), share capital (own and borrowed) (K) and the staff expenses per employee (Cs).

We mention that above emphasized indicators as variables of the models were calculated per hectare, and the model complied with the main rule of applying the DEA approach, respectively the DMU number, to exceed the number of considered variables.

The variables tested this way were used for generating the scores, by the CCR and BCC models. The CCR model allowed obtaining the technical efficiency (ET), and the BCC model allowed calculating the pure technical efficiency (ETP). Starting from the results obtained by the two models it is generated the scale efficiency ES that reflects the potential productivity that can be reached to an optimal level of DMU [1]:

$$ES = \frac{ET}{ETP}$$

DEA Model oriented towards [11]:

$$Max\phi + \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right]$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = x_{i0}, i = 1,2...,m;\ j = 1,2...,n; \lambda_j, s_i^- \geq 0$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = \phi y_{r0}, r = 1,2...,s;\ j = 1,2...,n; \lambda_j, s_i^- \geq 0$$

where: "n" number of DMU (exploitations); each DMU has 'm' inputs and produces 's' outputs; in year 'j' a DMUj consumes 'x_{ij}' from the input 'i' and produces y_{rj} of outputs 'r'; λ_j represent the amounts assigned by the linear program, 'ϕ' represents the calculated efficiency; 's_i' and 's_r' are the input and output errors; 'ε' is an element defined as lower than any positive real number [10].

For analyzing the scores we used the program MaxDEA 6.3 Beta, which allows the production of CRS (ET), VRS (ETP) and ES scores, under the model oriented towards output and hierarchy of the agricultural exploitations depending on these.

The assessment of the technical and scale efficiency of the agricultural exploitations taken for study was performed by the DEA method starting with the financial – accounting situations of the exploitations taken as case studies (***E1- Arenda Teleşti, E2-***

Agri, E3-Dra&Cor sub 500 ha; E4-Agro Loena, E5-AVE Agrosilv, E6-Arhonda cu 500-1000 ha; E7- Criscom, E8- Mobil MFM, E9 -Buzoieşti with over 1000 ha).

The assessment of the economic and financial performances of the agricultural exploitations taken for the study was realized starting with the financial and accounting situations of the explorations taken as case studies (***E1-Arenda Teleşti, E2-Agri, E3-Dra&Cor sub 500 ha; E4-Agro Loena, E5-AVE Agrosilv, E6-Arhonda cu 500-1000 ha; E7- Criscom, E8- Mobil MFM, E9 -Buzoieşti with over 1000 ha***) (Annexes 5.1-5.9) of the period pre-project (2005-2008) and the period post-project (2009-2014).

RESULTS AND DISCUSSIONS

Assessment of the technical and scale efficiency of the exploitation activity

Within DEA method oriented towards output, it is considered more efficient the exploitation that generates a higher level of output with the same quantity of input.

In 2008, at the moment of accessing the investment funds only E9 (Buzoieşti) was operating in optimal parameters, the exploitations E2 and E5 were the most inefficient, the exploitations E3, E6 and E8 were inefficient in proportion of over 50%, and the E4 and E7 exploitations had a high inefficiency. On the other side, the scores of pure technical inefficiency show us that the report between the exploitations expenses and the exploitations incomes was disproportionate in the E1, E2, E5 and E8.

Considering that most of the exploitations present a tendency for increasing the inputs in order to increase the incomes (situation proved also by the regression model), the scale efficiency was high and over the average, in the E1, E4, E5, E7 and E8 exploitations, which means that such exploitations could increase their relative efficiency with around 20-30% by redimensioning the exploitation activities.

In 2014, the score of technical efficiency was with 7,96% higher than in 2008 (de 0,501) which proves that the exploitations taken for the study could obtain the current exploitations incomes with only 50.1% from the current exploitations expenses. In other words, the analyzed exploitations, in order to function efficiently, should obtain with 49.9% more incomes than at the moment. Within the previously mentioned exploitations, with potential to be raised, it can be observed that in five years from implementing the investment, the situation is as follows (Table 1):

- E1 knew a decrease around 30% of the technical efficiency, reaching to a score of 0,113, meaning that it should obtain with almost 90% more incomes for the exploitation expenses, currently made;

Table 1. Model DEA – technical efficiency, pure technical efficiency, scale efficiency – exploitation activity

DMU	2008				2014				2014/2008 %		
	ET	ETP	ES	Scale profitability	ET	ETP	ES	Scale profitability	ET	ETP	ES
E1	0.159	0.193	0.822	Decreasing	0.113	0.150	0.752	Decreasing	71.2	77.8	91.4
E2	0.025	0.044	0.563	Increasing	0.534	1.000	0.534	Increasing	2161.0	2278.6	94.8
E3	0.433	1.000	0.433	Increasing	0.579	0.580	0.999	Increasing	133.6	58.0	230.5
E4	0.676	1.000	0.676	Increasing	0.879	1.000	0.879	Increasing	130.2	100.0	130.2
E5	0.019	0.024	0.776	Increasing	0.506	0.611	0.829	Decreasing	2713.4	2539.1	106.9
E6	0.493	1.000	0.493	Increasing	0.210	0.215	0.975	Increasing	42.7	21.5	198.0
E7	0.880	1.000	0.880	Increasing	**1.000**	**1.000**	**1.000**	Constant	113.6	100.0	113.6
E8	0.490	0.553	0.886	Increasing	0.200	0.296	0.675	Decreasing	40.8	53.5	76.2
E9	**1.000**	**1.000**	**1.000**	Constant	0.485	0.523	0.927	Decreasing	48.5	52.3	92.7
Average	0.464	0.646	0.725	-	0.501	0.597	0.841	-	108.0	92.5	115.9

Source: MaxDEA own processing

- E8 knew an even higher decrease of the technical efficiency (around 50%) reaching to a score of 0,200, meaning that it should obtain with 80% more incomes to the exploitation expenses, currently performed;
- E4 and E5 experienced significant increases of the technical efficiency (especially E5), which allow them to increase their scale

economies, these being due to increase their relative efficiency with only around 13-18%;
- E7 reached in 2014 the most efficient exploitation, proving an optimal report between the exploitation expenses and the exploitation incomes.

Also, we can see an improvement of the technical efficiency also in the E2 and E3 exploitations, which obtained scores over the average, exceeding the level of 50%. But the situation is more deficient within the E8 exploitation, which, after reaching its optimal technical level in 2008, in 2014 reached an inefficiency of 52%, although if due to its high dimension it has a high scale efficiency (92,7%).

In conclusion, we can say that in five years after implementing the projects, the small and middle exploitations are the most efficient, technically, while the large exploitations managed to prove a relative efficiency only due to the high dimension. Thus, we have an improvement of the technical efficiency at the level of the exploitation activity, especially in E4, E2, E3 and E5 and only one large exploitation (E7).

Assessment of the technical and scale efficiency of the general activity of agricultural exploitations

The analysis of the general activity of the agricultural exploitations starts from choosing as variables some clear indicators, for characterizing the production factors (earth, capital, labour). Thus, the nonparametric DEA method that was used in order to emphasize the efficiency of the results obtained by the agricultural exploitations, under the conditions of the current inputs, considered as variables the following inputs: area (S); intangible assets (A); Capital (own and borrowed) (K); Staff expenses per employee (Cs); Output: total incomes (Vt). In order to ensure the comparability of the economic indicators they were established by hectare.

The analysis of the efficiency indicators was realized based on the data envelopment analysis method, with the model CRS (constant return to scale) and VRS (variable return to scale). The research implied the assessment of the efficiency scores with constant scale efficiency (technical efficiency – ET), assessment of the efficiency scores with variable scale profitability (pure technical efficiency), assessment of the efficiency through the scale economy (reporting the CRS score to the VRS score, scale efficiency - ES).

In 2008, when the investment funds were accessed, the E2, E3, E6, E7 and E8 exploitations were optimal, operationally. With an average of 94,9% at the level of all exploitations of the technical efficiency, we can say that for the current inputs, the exploitations should have obtained total incomes with only 5,1% more. The E1, E4, E5 and E9 exploitations had high efficiencies, over 70%, and the scores of pure technical efficiency show us a non-proportionality between inputs and outputs, only in the E1 and E9 exploitations.

But the situation, in five years after projects' implementation shows us a slight deterioration of the exploitations' activity. While E2, E6 and E8 exploitations manage still to function in optimal parameters, E3 and E7 know a decrease in efficiency, especially E7. All this situation made that in 2014, for the score of the technical efficiency to be with 6,9% lower in 2008 (de 0,883) which proves that the exploitations taken for the study might obtain current incomes with only 88,3% of the considered inputs. In other words, the analyzed exploitations, in order to operate efficiently, should obtain with 11,7% more incomes that at the moment.

Except the previously mentioned exploitations, which maintained their technical optimal point (E2, E6 and E8), it is observed the following situation, in five years after implementing the investment (Table 2):

-E1 – knew a decrease with around 15% of the technical efficiency, reaching a technical optimum;

-E3 – after reaching its optimal point in 2008, in 2014 reached to have an inefficiency of 15,5% ;

-E4 – knew an increase around 6% of the technical efficiency, reaching the technical optimum;

-E5 – although remains with a high efficiency, knows a decrease around 2%, reaching in 2014 to have inefficiency around 3%;

Table 2. Model DEA – technical efficiency, pure technical efficiency, scale efficiency – general activity of agricultural exploitations

DMU	2008				2014				2014/2008%		
	ET	ETP	ES	Scale profitability	ET	ETP	ES	Scale profitability	ET	ETP	ES
E1	0.871	0.877	0.993	Decreasing	1.000	1.000	1.000	Decreasing	114.8	114.0	100.7
E2	**1.000**	**1.000**	**1.000**	Increasing	**1.000**	**1.000**	**1.000**	Increasing	100.0	100.0	100.0
E3	1.000	1.000	1.000	Increasing	0.845	1.000	0.845	Increasing	84.5	100.0	84.5
E4	0.940	1.000	0.940	Increasing	1.000	1.000	1.000	Increasing	106.4	100.0	106.4
E5	0.990	1.000	0.990	Increasing	0.974	1.000	0.974	Decreasing	98.4	100.0	98.4
E6	**1.000**	**1.000**	**1.000**	Increasing	**1.000**	**1.000**	**1.000**	Increasing	100.0	100.0	100.0
E7	1.000	1.000	1.000	Increasing	0.686	0.704	0.976	Constant	68.6	70.4	97.6
E8	**1.000**	**1.000**	**1.000**	Increasing	**1.000**	**1.000**	**1.000**	Decreasing	100.0	100.0	100.0
E9	0.737	0.809	0.912	Constant	0.446	0.606	0.735	Decreasing	60.4	75.0	80.6
Average	0.949	0.965	0.982	-	0.883	0.923	0.948	-	93.1	95.7	96.5

Source: MaxDEA own processing

Thus, we find that E9 – remains the most inefficient exploitation; in 2008, it should have obtained with almost 26% more incomes with the held inputs, in 2014, this percent grew to 55%; the exploitation knew even a decrease of the scale profitability, proving that the inputs are not adjusted to the proper dimension of the developed activities.

CONCLUSIONS

Conclusions on the technical efficiency – The assessment of the technical and scaling efficiency for the studied agricultural exploitations, realized with the DEA method, considered two models that followed-up the scaling of exploitations, depending on the technical efficiency of the agricultural activity, as a whole. The analysis of the technical efficiency, pure technical efficiency and scale efficiency scores (from 2008 to 2014) allowed us to reach the following conclusions:

- we have an improvement in the technical efficiency – *at the level of the exploitation activity*, especially in E2, E3, E4 and E5 and only an exploitation of large dimensions (E7);
- we have an improvement of the technical efficiency at the level of the general activity, especially in E1 and E4, while exploitations E2, E6 and E7 maintained their technical efficiency.

Thus, we can certify that the contributions granted by Pillar II of CAP, related to PNDR 2007-2013, Measure 121 creates a major pressure on the agricultural exploitations performances, with an impact especially on the long term financial profitability, and also on the general activity, in exploitations under 500 hectares.

However, our assessment emphasizes that the small and middle exploitations are more efficient, while the large exploitations suffered major decreases of the technical efficiency, following the performed investments, decreases that can be the consequence of a deficient management.

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