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The Impact of Technological and Socio-Economic Factors on the Efficiency of Agricultural Enterprises: Application of Stochastic and Deterministic Methods

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Abstract: Questions of improvement of methodology of an assessment of efficiency of the agricultural companies on the basis of the deterministic and stochastic approaches of measurement (DEA and SFA methods) are investigated in the study. Activity of these companies is caused by a set of administrative influences and environment factors. Researchers approach to carrying out the mixed assessment of efficiency is offered. Basic experiment of applicability of researchers approach is made at the agricultural enterprises of Kulunda Steppe of the Altai Region of Russia taking into account climatic and social and economic conditions.

Key words: Economic efficiency, effectiveness, deterministic and stochastic approaches, mixed measures DEA and SFA, Kulunda steppe

INTRODUCTION

Problem statement: The basis of management of the organization, regardless of its affiliation to the private or public sector, size, range of its activities as well as other specifying its characteristics make the measurement and analysis of the effectiveness of its functioning. Efficiency, one of the basic concepts of economic science. It focuses on itself constant attention of researchers of the economic theory and practice. Efficiency of the company is divided by the efficiency of production and efficiency of result of this process which correspond to concepts of economic efficiency and effectiveness.

Economic efficiency: The enterprise is the system functioning under certain social, economic and natural conditions $w \in W$, characterized by a set of inputs $x = (x_1, ..., x_S)$ and outputs $y = (y_1, ..., y_R)$. As inputs are identified used in the production resources management impact, causing a change in operating results. The outputs are the items that are purchased by the enterprise when converting resources or by management impact expressed in physical or value, quantitative or qualitative form (production volume, revenue, profit, etc.). A shared and common understanding of efficiency is that it is a ratio of inputs to outputs: Efficiency = Relation (output, input). It is known that relation is one of the main logical and philosophical categories, reflecting the way of life and knowledge and is a comparison/matching of two or more subjects. The relation of the measured resultants and entrance signs can have difference expression (an additive form of efficiency) or fraction (a rational form of efficiency) or in the mixed form:

$$\text{Efficiency\_Add} = \text{Output-Input}$$

$$\text{Efficiency\_Ratio} = \frac{\text{Output}}{\text{Input}}$$

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$$\text{Efficiency\_Add and Ratio} = \frac{\text{Output-Input}}{\text{Output}}$$

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Effectiveness: Effectiveness shows how received result corresponds to the target, set level. The size of a deviation of an actual state of object (x^0, y^0) from optimum (target) Ideal = (x^*, y^*) characterizes degree of its effectiveness and is estimated by the relation:

$$\text{Effectiveness} = \frac{U(x^0, y^0)}{\max\limits_{(x,y)\in T} U(x, y)} = \frac{U(x^0, y^0)}{U(x^*, y^*)} = \frac{U^0}{U^*}$$

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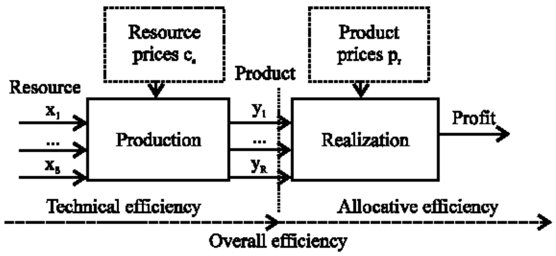

Fig. 1: Gradation of measurement of efficiency in compliance with decision-making stages

Optimum (ideal, target) the condition of the enterprise (x^*, y^*) is defined by some one or a set of criteria of an optimality $U(\cdot)$ at which the optimum is reached:

$$U^* = U(x^*, y^*) = \underset{(x,\, y)\in T}{\operatorname{extr}} U(x, y)$$

where, T a set of decisions realized in practice.

Types of efficiency: The categories of efficiency and effectiveness are associated the concept of the allocative and technical efficiency. The idea of decomposition measure the overall effectiveness of the technological and allocative components was proposed by Debreu (1951). Later, Farrell (1957) more clearly defined approach to assess the overall effectiveness (in the understanding of economic efficiency) and its decomposition on the allocative and technological components based on radial measures (Fig. 1).

If, however, the proportion of output provides maximum revenue, production activity is allocative effective production. The ratio potential flow of resources to the actual to the specified output characterizes the technological efficiency of the production cost (entrance) and allows to estimate the value of saving production costs on the actual output. The allocative efficiency of input is achieved with such proportions consumption of resources which provide for a minimum amount of production costs. The overall economic efficiency of the enterprise is characterized by the most efficient conversion of the input of financial flows in the economic result of its functioning. The effective company is technical and allocative effective both.

METHODOLOGICAL APPROACHES TO EFFICIENCY MEASUREMENT

The diversity of the concepts of efficiency measurement defines a wide range of tools in the research process. Approaches to measuring efficiency can be divided into coefficient and econometrics. Coefficient approach traditionally is used by scientists and experts. It is based on the analysis and comparison of the relative indicators presented in additive and mixed form and calculated based on the primary accounting data of the enterprise. The disadvantages of this approach are: the difficulty of assessing the contribution of social, economic and technological factors in the efficiency of the company. The use of methods of factor and regression analysis for solution of this task gives ambiguous results. Many evaluation criteria make it impossible to solve this problem. This requires the use of weighting coefficients for integral efficiency indicator. Problems of classification of companies according to the degree of efficiency associated with the multiplicity of performance criteria and with a significant dependence of the classification results on the method used.

The econometric approach is actively developed in the works of foreign scientists from the second half of the 20th century. The conceptual framework of this approach was founded in 1957 by Farrell (1957). It actively developed in the works of many economic scholars. In accordance with this concept, the company which is effective (efficiency Pareto-Koopmans) lie on the efficiency frontier (belonging to the efficient frontier is identified by the value of the characteristic parameter usually equal to one). In the framework of this concept is a widespread deterministic and stochastic approaches to the assessment of efficiency in particular, Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA).

The application of these methods are very diverse and are used as a tool for analysis of efficiency of complex socio-economic systems (oil companies, banks, industrial companies, public utilities, universities, hospitals and other commercial and non-commercial organizations). Widely these methods are used in the international practice of evaluating the performance of agricultural enterprises. In Russia, the results of researches of efficiency of the agricultural production on the basis of this methodology are very rare.

DEA belongs to the class of non-parametric, deterministic methods of performance measurement. The basic models DEA were proposed by Charnes *et al.* (1978) and Banker (1984) (CCR and BCC Model). The method is based on the construction borders of efficiency through consistent solutions of linear programming problems for each object selection and calculation of estimates of the degree of approximation to the boundary efficiency. Estimation of efficiency of activity of the company o (o = 1, ..., n) to DEA (IE_{DEA}) is based on the model CCR-output:

$$\varphi^* = \max_{(\varphi,\lambda,d^-,d^+)\in Q_o} \varphi$$

$$Q_o = \left\{ \begin{array}{l} \varphi \in R_+; \lambda \in R_+^n; (d^+, d^-) \in R_+^R \times R_+^S : \\ \sum_{j=1}^{n} \lambda_j x_{js} + d_S^- = x_{os}, s = 1, ..., S; \\ \sum_{j=1}^{n} \lambda_j y_{jr} - d_r^+ = \phi y_{or}, r = 1, ..., R \end{array} \right\} \quad (1)$$

Model (Eq. 1) requires a persistent effect on the scale of activity (Constant Return to Scale-CRS) and as a rule, the obtained solution is compared with the results obtained on the basis of model BCC-output, taking into account the variable effect of expansion of scales of activity (Variance Return to Scale-VRS) which is formed by adding in problem (Eq. 1) restrictions:

$$\sum_{j=1}^{n} \lambda_j = 1$$

The solution of problem (Eq. 1) for modifications CRS and VRS for each object of the sample are formed optimal in comparable terms assessment:

- Reserves of growth of output: φCRS, φVRS
- Relative efficiency evaluation: $IE_{DEA\_VRS} = 1/\varphi_{VRS}$; $IE_{DEA\_CRS} = 1/\varphi_{CRS}$
- Evaluation of inefficiency, related and influence of scale (Scale Efficiency-SE): $IE_{SE} = IE_{CRS}/IE_{VRS}$
- Estimation of reserves of saving resources d_S^- by type (s = 1, ..., S)
- Potential volume of production $y_{or}^* = y_{or}\varphi_o + d_{or}^+$ by type (r = 1, ..., R)
- Potential (marginal) costs of resources: $x_{os}^* = x_{os} - d_{os}^+$ (s = 1, ..., S)

Further, analysis of the results based on the DEA is the identification of key inefficiencies enterprises (indicators of different nature both reflecting the specifics of production, external conditions and the identification and specification of the model inefficiency (Tobit Model) for estimates from the VRS and CRS:

$$IE_{DEA} = \sum_{i=1}^{M} b_i^{DEA} z_i + \varepsilon$$

Where:

z_i = Investigated the factors contributing to the efficiency of production

ε = The inefficiency associated action unaccounted factors

Parametric method of stochastic boundary analysis of the SFA was developed by scientists (Aigner and Chu, 1968; Battese and Coelli, 1992). Efficiency assessment based on the method of SFA is associated with identification of the production function of the form:

$$y = f(x, \beta) + \varepsilon \quad (2)$$

where, ε the deviation from the boundary evaluation edition (ε = v-u), containing the following components: v random error with the standard normal distribution N (0, σ_v^2), characterizing the impact on the output of the external random factors not accounted for in the model in particular the climate, soil conditions and not related to the inefficiency of the activity; μ the inefficiency of production which is independent of v and reflecting the impact on the production process of the complex factors that influence its efficiency as a rule, assumes the hypothesis half-normal distribution $N_+ (\mu_u, \sigma_u^2)$.

When using the maximum likelihood method the obtained estimates of the coefficients of model (Eq. 2) and an estimate of the variance of the value $\sigma_\varepsilon^2 = \sigma_u^2 + \sigma_v^2$, the parameter $\gamma = \sigma_u^2/\sigma_\varepsilon^2$ characterizes the proportion of variance explained by inefficiency of detail of the enterprise. Estimation of efficiency of activity of the agricultural organizations on the experience of researchers are carried out as a rule, based on Cobb-Douglas production function:

$$y = e^{v-u} \times \beta_0 \times x_1^{\beta_1} \times ... \times x_S^{\beta_S}$$

when we get logarithmically:

$$\ln y = \beta_0 + \sum_{s=1}^{S} \beta_s \ln x_s + v - u$$

The index of efficiency is based on the method SFA is calculated as:

$$IE_{SFA} = \frac{E(y^*, x, u: u \geq 0)}{E(y^*, x, u: u = 0)}$$

where, H($\cdot$) the calculation function of boundary level y^* when the actual condition of consumption of resources x, depending on the degree of efficiency (u = 0 border assessment, u≥0 evaluation given the inefficiency). To obtain numerical estimates of the efficiency on the basis of methods of SFA is widely used program, FRONTIER 4.1, developed by the researchers of the method in 1991. Use of estimates the efficiency IE_{SFA} allows to identify Tobit Model of efficiency in the aggregate, affecting social and economic factors:

$$z_i \ (i = 1, ..., M): IE_{SFA} = \sum_{i=1}^{M} b_i^{SFA} z_i + \varepsilon$$

Comparative analysis of statistically significant coefficients b_i^{SFA} and b_i^{DEA} for a number of years reveals a significant, stable in time factors responsible for the efficient functioning of enterprises in the survey area. As the experience of practical use of these methods by various researchers, obtained estimates of efficiency is often are consistent with the use of models oriented on the output-oriented (correlation effectiveness evaluations significant and often exceed 0.8). The results of the evaluation of the efficiency on the basis of additive models DEA are poorly coordinated with SFA in the correlation between the estimates at 0.5.

METHODOLOGY MIXED EFFICIENCY MEASUREMENT

The application of these methods in the complex allows get more objective conclusions about the efficiency and its dynamics during the analyzed period. As noted by Murillo-Zamorano (2004), synthesis of stochastic and deterministic approaches, nonparametric and parametric methods is one of the priority directions of scientific research of the boundary methodology.

We will adopt the following principles of generalization of the results of the methods of DEA and SFA: methods must not return conflict results; evaluation of efficiency should not enter into contradiction with the results obtained using traditional indicators of efficiency (profitability); evaluation of efficiency should be stable in time when relatively stable external conditions shall be observed significant fluctuations estimates from one time period to another. In connection with absence in the literature concepts synthesis efficiency evaluations on these methods, the researchers propose to use the following approach.

Let be IE_{DEA}, IE_{SFA} the estimations of efficiency of activity of enterprises on the basis of methods of DEA and SFA (IE_{DEA}, $IE_{SFA} \in [0, 1]$). In the state space as effective as possible (maximum effective) in which the state corresponds to the coordinates (IE_{DEA}, $IE_{SFA} \in [1, 1]$). Accordingly, the deviation from the boundary condition can be measured as the ratio of the distance, relative to the origin (maximum inefficient state of the object) actual estimates the distance to the ideal position of the object:

$$IE_{DEA\&SFA} = \frac{D\,(IE_{DEA}, IE_{SFA}; 0, 0)}{D\,(1, 1; 0.0)}$$

where, $D(\cdot)$ the function of the distance between points. Considering that the measures the Euclidean distance get that mixed assessment of the efficiency of objects (Mixed Measures DEA and SFA) on the basis of stochastic and deterministic approaches can be defined as:

$$IE_{DEA\&SFA} = \left(\frac{IE_{DEA}^2 + IE_{SFA}^2}{2} \right)^{1/2} \quad (3)$$

Comparative analysis of efficiency measurement IE_{DEA} and IE_{SFA} allows to detect abnormal objects for which these methods give significantly different results, i.e., $|IE_{DEA}-IE_{SFA}|>\mu$ (μ the critical level of difference). The objects for which there is a high inconsistency assessments IE_{DEA} and IE_{SFA} excluded.

The mixed results of performance evaluations formed the final grouping objects in efficiency and an extended list of indicators. Based on the analysis of the results and methods of classification of economic interest in literature made the following boundary-value index $IE_{DEA\&SFA}$: for effective firms: $IE_{DEA\&SFA} \in [0.9;\ 1]$for inefficient firms: $IE_{DEA\&SFA} \in [0.5;\ 0.9]$ for much of inefficient firms: $IE_{DEA\&SFA} \in [0.1;\ 0.9]$ and for abnormally ineffective firms: $IE_{DEA\&SFA} \in [0.1;\ 0.5]$. Abnormally, ineffective companies are analyzed separately and often are special objects and emissions.

Thus, regardless of the technologies of production, research organization and management at the enterprise in assessing the effectiveness focuses on how efficiently resources are used at the entrance are converted into results at the output. Identifying those most effectively carry out this conversion in the future, you must enter the inside and identify the principles of their functioning, i.e., the typology of enterprises and obtaining a portrait of effective or ineffective entity. Using the pooling of interest with regard to extended characteristics and their interpretation is formed typical portrait effective enterprises.

THE MAIN RESULTS OF THE ESTIMATION OF EFFICIENCY OF AGRICULTURAL ENTERPRISES OF THE ALTAI REGION OF RUSSIA IN 2008-2012

As the survey area is considered the Kulunda steppe of the Altai Region, Russia in the framework of which there are 32 municipal districts and agricultural production is engaged 576 agricultural organizations, 1325 private (peasant) farms and individual entrepreneurs and 228 thousand household farms. Selection of observations focused on the category of the agricultural organizations of private and collective forms of ownership. The sample size was 100 units, the observation period is 5 years, the method of formation-random. For database results used solid statistical observation of the Central Administrative Board of Agriculture of Altai Region. The territory of the

Kulunda steppe is characterized by diversity of climatic and soil conditions and is divided into three zones: the zone of Dry Steppes (DS), Typical Steppes (TS) and Forest (FS). One aspect is to identify the nature of the influence of location of the enterprise, the scale of activity on the results of its functioning. Observation period 2008-2012 is characterized by diversity of climatic conditions in the region (from severe drought, a minimum of crops productivity and growth of prices in 2012 to favorable climatic conditions and higher productivity in crop production but a strong price decline in 2009). Study of dynamics of the efficiency indices during this period an indirect sign of adaptability of enterprises to changing environmental conditions. The list of initial parameters (output, input and investigated social and economic factors) for a sample of objects is given in Table 1. As a basic model are considered models targeted for output (when one output 8 inputs and 14 indicators used in the model building efficiency).

As a result of application of methods of DEA and SFA are obtained estimation of efficiency, increase productivity and profitability in agricultural company accounts steppe Altai Region for the period 2008-2012 (Table 2). Analysis of results allows make the following conclusions:

- Indicators of efficiency of production as a whole in conditions of dry steppe lower than in other territories
- The share of the effective enterprises in the overall sample is 18-25% while in conditions of forest steppe in adverse climatic conditions 2012 there was a sharp drop in the number of effectively managing subjects
- Reserves of increase crop yields amount to 2-3 center per ha and revenue -0.85, -1.36 thousand RUB per ha
- Increase of rentability of crop production with the effective functioning of existing economic conditions possible on 48-62%
- Maximum economy to achieve effective state when the crop production was achieved in 2008 and 2011 for the cost of spare parts in 2009 other costs in 2010 payment for services in 2012 the cost of diesel, fuel and energy

Correlation efficiency evaluations IE_{DEA_CRS} and IE_{SFA} is 71-84%, IE_{DEA_VRS} and IE_{SFA} is 53-81%, IE_{DEA_VRS} and IE_{DEA} is 88-96%. The result is censoring sample of abnormal objects detected in 2012-10 in 2011-7, 2010-4; in 2009-6 and in 2008-4. The results of structure-parametric identification of models of efficiency emitting statistically significant factors presented in Table 3. The level of determination for all of the models exceeds 0.8. Sustainable determinants of crop production efficiency are:

- Total area of crops including pairs (revealed that in 2008, 2009 and 2011 enterprises with large area of sowing acted less effective)

Table 1: Average value of the basic parameters of crop production sample of the agricultural enterprises on the territory of the Kulunda steppe Altai Region (Russia)

Parameters	Variables	2008	2009	2010	2011	2012
Output						
Revenues from crop products (thousand RUB)	y	26,292	22,466	30,209	26,706	23,738
Inputs						
Seeds (thousand RUB)	x1	3,643	4,484	3,851	4,833	5,762
Fertilizers (thousand RUB)	x2	470	390	377	671	531
Herbicides (thousand RUB)	x3	1,003	1,090	1,162	1,547	1,475
Energy, oil, fuel and diesel (thousand RUB)	x4	7,118	5,805	5,439	6,064	6,488
Machine spares and materials for repair (thousand RUB)	x5	4,099	3,624	3,652	3,557	3,911
Payment for services (thousand RUB)	x6	1,373	2,005	2,180	2,365	2,284
Salary (thousand RUB)	x7	5,137	5,834	6,421	7,636	7,127
Other kind of cost (thousand RUB)	x8	2,582	2,919	2,987	3,819	3,226
Studied social and economic factors						
Sown area (ha)	z1	12,068	11,062	11,097	10,921	10,774
Share of revenues from crop production in total (%)	z2	65	63	62	57	54
Share of revenues on crop production from grain and leguminous (%)	z3	77	69	69	66	64
Subsidies (thousand RUB per ha)	z4	0.321	0.031	0.039	0.205	0.161
Number of employees (number of persons)	z5	33	32	31	28	27
Average age of the managers of the companies (years)	z6	53.1	53.1	53.1	53.1	53.1
Presence of special education managers of companies (number of persons with education)	z7	69	69	69	69	69
Average term of the management company (years)	z8	11	11	11	11	11
Yield of grain and leguminous crops (quintals per ha)	z9	10.6	15.0	11.9	9.8	5.4
Belonging to the territory of Kulunda steppe						
DS	z10	38	38	38	38	38
TS	z11	45	45	45	45	45
FS	z12	51	51	51	51	51
Type of ownership of the company						
A	z13	60	60	60	60	60
B	z14	40	40	40	40	40

A: indicates the number of companies of private ownership; B: is the number of companies with state and public forms of property

Table 2: Results of measuring of crop production efficiency in the Kulunda steppe, Altai Region, Russia

Territory	2008	2009	2010	2011	2012	Average
The efficiency in revenue ($IE_{DEA\&SFA}$)						
Dry Steppe (DS)	0.61	0.68	0.73	0.62	0.58	0.64
Dry and Typical Steppe (DS-TS)	0.72	0.69	0.77	0.71	0.63	0.70
Typical Steppe (TS)	0.68	0.70	0.78	0.69	0.71	0.71
Typical Steppe and Forest Steppe (TS-FS)	0.73	0.73	0.77	0.71	0.63	0.71
Forest Steppe (FS)	0.65	0.76	0.77	0.74	0.65	0.71
The share of efficient enterprises in the total number ($IE_{DEA\&SFA} \geq 0.9$)						
Dry Steppe (DS) (%)	18.00	24.00	12.00	12.00	24.00	18.00
Dry and Typical Steppe (DS-TS) (%)	24.00	14.00	29.00	19.00	10.00	19.00
Typical Steppe (TS) (%)	9.00	18.00	27.00	18.00	27.00	20.00
Typical Steppe and Forest Steppe (TS-FS) (%)	31.00	8.00	38.00	31.00	15.00	25.00
Forest Steppe (FS) (%)	16.00	32.00	26.00	26.00	13.00	23.00
Reserves revenue growth (thousand RUB per ha)						
Dry Steppe (DS)	1.29	0.60	0.53	0.76	1.09	0.85
Dry and Typical Steppe (DS-TS)	1.77	0.67	0.49	0.61	0.94	0.90
Typical Steppe (TS)	1.25	0.97	0.63	0.94	0.82	0.92
Typical Steppe and Forest Steppe (TS-FS)	1.23	0.98	0.85	1.05	1.36	1.09
Forest Steppe (FS)	2.29	0.79	1.03	1.13	1.59	1.36
Reserves of increase of productivity of grain and leguminous crops (centner per ha)						
Dry Steppe (DS)	2.67	2.01	1.54	1.60	1.76	1.91
Dry and Typical Steppe (DS-TS)	3.80	1.91	1.67	1.36	1.69	2.08
Typical Steppe (TS)	2.57	3.32	1.64	2.36	1.37	2.25
Typical Steppe and Forest Steppe (TS-FS)	2.55	3.31	2.66	2.52	2.85	2.78
Forest Steppe (FS)	4.56	2.53	3.06	2.40	2.80	3.07
Reserves of increase of rentability (%)						
Dry Steppe (DS) (%)	76.00	40.00	54.00	53.00	61.00	57.00
Dry and Typical Steppe (DS-TS) (%)	49.00	42.00	43.00	36.00	69.00	48.00
Typical Steppe (TS) (%)	84.00	50.00	32.00	44.00	44.00	51.00
Typical Steppe and Forest Steppe (TS-FS) (%)	76.00	54.00	53.00	57.00	69.00	62.00
Forest Steppe (FS) (%)	77.00	41.00	48.00	57.00	60.00	57.00

Table 3: Summary assessment of the nature of influence of a complex of socio-economic factors on the efficiency of crop production

	2008			2009			2010			2011			2012			
Variables	DEA	SFA	+/-	DEA	SFA	+/-	DEA	SFA	+/-	DEA	SFA	+/-	DEA	SFA	+/-	Total
z1	-0.70	-0.22	-	-0.350	-0.07	-	-0.17	0.020	-/+	-0.71	-0.0100	-	-0.20	0.0100	-/+	-/+
z2	0.35	0.26	+	0.420	0.44	+	0.32	0.190	+	0.25	0.2100	+	0.21	0.0200	+	+
z3	0.08	0.01	+	0.030	0.01	+	-0.06	0.010	-/+	0.00	-0.0600	+/-	0.15	0.0020	+	+/-
z4	-0.04	-0.08	-	0.130	-0.12	+/-	-0.10	0.020	-/+	0.07	-0.0900	+/-	-0.01	-0.0030	-	-/+
z5	-0.27	0.16	-/+	-0.020	0.29	-/+	-0.11	0.080	-/+	0.04	0.1100	+	-0.41	0.0100	-/+	+/-
z6	-0.03	0.05	-/+	0.110	0.19	+	0.12	0.130	+	-0.04	-0.0300	-	-0.06	0.0100	-/+	+/-
z7	0.01	-0.01	+/-	0.030	0.02	+	-0.02	-0.020	-	0.03	0.0400	+	0.03	0.0003	+	+/-
z8	-0.07	0.01	-/+	-0.100	-0.07	-	-0.04	0.030	-/+	-0.01	0.1000	-/+	-0.08	-0.0020	-	-/+
z9	0.19	0.13	+	0.040	0.21	+	-0.05	0.180	-/+	-0.32	0.1100	-/+	-0.05	0.0100	-/+	+/-
z10	0.28	0.03	+	0.030	-0.02	+/-	-0.05	0.020	-/+	-0.06	-0.0400	-	-0.05	-0.0010	-	-/+
z11	0.12	0.04	+	0.020	-0.02	+/-	0.07	0.020	+	0.04	-0.0400	+/-	0.05	0.0004	+	+/-
z12	0.18	-0.01	+/-	-0.001	-0.02	-	-0.07	0.003	-/+	-0.03	0.0003	-/+	-0.07	-0.0010	-	-/+
z13	0.18	0.42	+	0.530	0.12	+	0.77	0.400	+	0.94	0.4400	+	0.74	0.8700	+	+
z14	0.13	0.42	+	0.460	0.12	+	0.78	0.380	+	0.92	0.4500	+	0.77	0.8700	+	+

- The share of revenues from crop production (with a more pronounced crop specialization producers are offered a higher level of technological efficiency)
- Number of employees at the enterprise has a different effect from the end of 5 years in 2008, 2009 and 2012 is a statistically significant factor
- The age of the head has a predominantly positive impact on efficiency but rarely is a statistically significant factor
- The yield of grain and leguminous has a positive effect on efficiency in 2008 and 2009 in other periods are recorded contradictory assessments
- Collective and state form property of the organization is less effective in respect of the private forms in 2008 to 2009

It should be noted that the amount of state support is not a significant factor that indirectly testifies to its failure.

CONCLUSION

The annual research of efficiency of agricultural production on the basis of data of solid statistical observation of agricultural enterprises allows solve a number of practical problems of production management at different levels of territorial administration. The purpose of practical application of methods of DEA and SFA largely determines the context of the study used the concept of performance measurement and accordingly, the structure of the source data (input, output, the list of social and economic factors, additional indicators to be used to obtain general of the type effective enterprise). A study in the dynamics of efficiency (several years) allows reveal exposure to significant fluctuations key performance indicators to identify the most effective practices in production in favorable and adverse weather conditions.

REFERENCES

Aigner, D.J. and S.F. Chu, 1968. On estimating the industry production function. Am. Econ. Rev., 58: 826-839.

Banker, R.D., 1984. Estimating most productive scale size using data envelopment analysis. Eur. J. Oper. Res., 17: 35-44.

Battese, G.E. and T.J. Coelli, 1992. Frontier production functions, technical efficiency and panel data: With application to paddy farmers in India. J. Prod. Anal., 3: 153-169.

Charnes, A., W.W. Cooper and E. Rhodes, 1978. Measuring the efficiency of decision making units. Eur. J. Oper. Res., 2: 429-444.

Debreu, G., 1951. The coefficient of resource utilization. Econometrica, 19: 273-292.

Farrell, M.J., 1957. The measurement of productive efficiency. J. R. Stat. Soc. Ser. A, 120: 253-290.

Murillo-Zamorano, L.R., 2004. Economic efficiency and frontier techniques. J. Econ. Surveys, 18: 33-77.