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## **Developing an Integrated Methodology for Estimating Economic Efficiency of Production in Agricultural Enterprises Republic of Moldova**

**Abstract.** This paper presents an analysis to estimate the economic efficiency of agricultural products and global production in agricultural enterprises in Moldova. It was determined by using a system of partial indicators of economic efficiency dynamics from 2005-2012. Along with traditional indicators, a calculation methodology developed by a synthetic indicator for (full) efficiency was used, taking into account basic indicators of production and sales. The recommended methodology enables: trace-back to each farm unit for economic efficiency compared with border hierarchy of optimal studied (standard) levels of identification, with results by influence; determining reserves to increase economic efficiency etc. The following methods are based on economic statistics research: monographic method, method table, DEA (Data Envelopment Analysis). In the research the author used data from specialized forms of agricultural enterprises from the Statistical Yearbook (NBS).

**Key words:** economic efficiency, full indicator, methodology of assessment, system of indicators, the optimal frontier (benchmark), Moldova

### **Introduction**

The research conducted allow us to state that the essence of efficiency of agricultural production is the formation of complex requirements and conditions necessary to ensure extended reproduction in a competitive economy, enabling the industry to meet society's needs not only for food, but also to develop harmony under operation ties and economic relations, organizational, legal, social, moral and also in terms of ensuring sustainable agriculture. Increasing useful effects must be the aim of all economic activities, but with the condition of keeping ecological balance. The organization's extended reproduction depends on the level of economic efficiency, because profits create prerequisites and conditions necessary to enlarge reproduction processes.

### **Material and Methods**

In the research the author used data from the Statistical Yearbook; specialized forms of agricultural enterprises in Moldova [2011-2012]. The research issues addressed in the paper were used: monographic method, method of comparison, graphics, table, grouping method, economic indices, the method of envelopment (DEA).

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## **Results and discussion**

Changing business conditions in agricultural units with different legal forms of ownership and organization require new approaches and complex analytical research. Results should determine not only changes in dynamic links between phenomena, but also serve as a basis for taking appropriate decisions in planning and foreseeing future development of production. Practical benchmarking of existing production efficiency in terms of the forms of production is represented by very different indicators, which often characterize various aspects of the production process conditions and do not reflect the full extent of the functioning link between the results of production and means of obtaining them.

We must mention that results from the production of agricultural production relate to each type of resource (factor) basis. But it is obvious that the results of are for fully participating resources (agricultural land, capital goods for agricultural production), consumption of materials, labor, etc.) and market conditions (supply, demand, competition etc.).

To feature any sector of production efficiency in the agricultural branch we must use a system of indicators expressing special factors that influence the final results of production. These indicators reflect the level of use of agricultural land, means of production, indicates material costs, labor etc.

The efficiency of production is characterized by the effect achieved, which should always affect production. Based on data for agribusinesses in Moldova, according to the system of indicators to determine economic efficiency we looked at producing grapes for 2005-2012. A high economic efficiency was achieved in 2005, 2011 and 2012, when grape productivity had high levels recorded and when the correlation between the sales price and the cost of finished products sold was the greatest. For every 1 leu consumed, businesses achieved an average profit of 31.02 and 36.99 cash money.

Productivity of vine plantations is a basic indicator characterizing economic efficiency in viticulture, while increasing the intensification and financing remains a problem for agricultural enterprises. Increasing or reducing the productivity of plantations and changing their quality determines the effectiveness of grape production. But only on the basis of partial indicators, it is not possible to assess the full economic efficiency. These indicators reflect partial economic efficiency, as each of them relates only to a certain category of resource. The latest research studies aimed at production efficiency use the stochastic frontier method, which is a method to estimate the production frontier and, therefore, a method of measuring the efficiency of production.

Maximum efficiency is often called "best practice," which always is the production possibilities frontier, and therefore efficiency change means changing the distance from the border [Лиссирца 2003]. The method of analysis - tire belongs to Farrelly [Farrell 1957], according to which efficiency is calculated as the ratio of agricultural enterprises productivity maximum productivity.

Nonparametric techniques, envelopment, were further developed by Charnes, Cooper and Rhodes [Charnes et.all. 1978]. It's all about methodology called DEA, which uses mathematical programming models to build tire production possibilities crowd. The peculiarity of this method is that all observations are assumed to be the same for the production side of the border and the term "error" only captures inefficiency.

We agree with the Russian researcher A. P. Zincenco, who is of the opinion that the selection of characteristics necessary to comply with the qualitative requirements regarding homogeneity inexistence have contradictions between them. This condition can be considered fulfilled if the characteristics usually has changes in direction and the strength of their bond is high [Зинченко 2007]. Studying Russian economic literature shows that this method is not used in practice and it is unknown. However, the potential need to use the method and effect can be large [Лисситса 2003 et. all.].

DEA envelopment priority method as an alternative to other methods of estimating the efficiency consists of the following:

- multiples border outputs can be found easily;
- there is no need to search for the type and form tool because the production possibilities frontier is determined as a data envelopment.

We believe that to determine the full economic efficiency of production it is necessary to calculate, along with traditional indicators, a synthetic indicator (Full) efficiency, such as a multi-criteria environmental coefficient calculated on each farm in the total crowd under the main indicators which characterizes the efficiency. The proposed methodology is based on the principles of the method, which is called analysis - tire.

Each combination of resources yield maximum results, but your results may actually coincide with the maximum level or may be lower. Undertaking obtaining maximal results with respect to a resource unit is taken as a yardstick by which compares all companies studied by the use of resources. Businesses efficient form "efficient production frontier". So estimating efficiency is determined by calculating the distance between enterprises and the studied efficiency frontier.

When selecting characteristics necessary to comply with the qualitative requirements regarding the nonexistence homogeneity contradictions between them. This condition can be considered fulfilled if the lot is changing characteristics usually in one direction and strength of their bond is high.

At the product level is proposed to compute the average multi-criteria after following relationship is apparent in the methodology developed:

$$\bar{C}_i = \frac{\frac{p_i}{p_{opt}} + \frac{Cp_{opt}}{Cp_i} + \frac{Pm.v_i}{Pm.v_{opt}} + \frac{Pq_i}{Pq_{opt}} + \frac{Nr_i}{Nr_{opt}}}{n} = \frac{\sum_{n=1}^n \left( \frac{x_{i_n}}{x_{opt}} \right) + \frac{x_{opt}}{x_i}}{n} \quad (1)$$

where:

$\bar{C}_i$  - the average coefficient for the multi-criteria of economic efficiency units;  
 $p_i$  și  $p_{opt}$  – crop yield from 1 ha, (q) for the unit and the unit with optimal frontier level (standard);

$Cp_i$  și  $Cp_{opt}$  – unit cost of production (millions) for the unit and the unit optimal border;

$Pm.v_i$  și  $Pm.v_{opt}$  – the average price of one stock q (MDL) for the unit and the unit with optimal border;

$Pq_i$  și  $Pq_{opt}$  – profit calculated to q product (MDL) for the unit and the unit with optimal border;

$Nr_i$  și  $Nr_{opt}$  – level of profitability (%) for the unit and the unit optimal border;

$x_{i_n}$  – xn characteristic meaning (for features maximized) for i units;  
 $x_i$  – meaning characteristic (for features minimized) for the unit;  
 $x_{opt}$  – feature importance for optimal frontier level (standard) –  $x_n$ ;  
 $i$  – the number of units surveyed the crowd;  
 $n$  – feature number.

We be mention that part of the production in the agricultural enterprises is not sold on distribution channels but is processed. We consider it necessary to express our opinion and to complete the proposed methodology taking into account the results obtained from the processing of their products, including an additional four indicators:

$c'_{p_i}$  și  $c'_{opt}$  – unit cost of finished products sold, lei for the unit and the unit optimal border;

$p'_{m.v.i}$  și  $p'_{m.v.opt}$  – stock price of one unit sold (tons, dal etc.), lei and drive units for the optimal frontier;

$Pq'_i$  și  $Pq'_{opt}$  – profit calculated per unit of product sold (millions) for the unit and the unit with optimal border;

$Nr'_i$  și  $Nr'_{opt}$  – profitability level (%) for the unit and the unit optimal border

Then the companies that process their own production determining the economic efficiency of different types of products taking into cosniderare the results obtained from the industrial processing of their plan to be carried out by the following relationship:

$$\bar{C}_i = \frac{\sum_{n=1}^n \left( \frac{x_{i_n}}{x_{opt}} + \frac{x'_{i_n}}{x'_{opt}} \right) + \frac{x_{opt}}{x_i} + \frac{x'_{opt}}{x'_i}}{n} \quad (2)$$

where:

Meaning x'n feature (for features maximized) for the units;

$x'_i$  – significance characteristic (for features minimized) for the unit.

$x'_{opt}$  – importance for the border optimal feature (standard) - x'n;

$i$  – number of units surveyed the crowd;

$n$  – number feature.

Based on the data of 130 agricultural enterprises of the South and ATU "Gagauz" - producing commodity production (grapes) was estimated as economic efficiency indicator system. Under the proposed methodology individual indices were calculated based on average coefficients which were determined using multi-criteria assessment of the effectiveness of each enterprise in the competitive environment. Based on average salary levels Multicriterial businesses were arranged in descending order, then determined the place it occupies in the competitive environment hierarchical organization from one enterprise to another.

The data shows that there is high competition agrarian market where sellers sell a lot of quality grapes with an assortment of different goods (varieties, the percentage of sugar, acidity, shape, color, etc.). The basic factor influencing the competitive priority is resource potential. Effective use of qualitative and quantitative indicators which determine the company's activity and efficiency of different products and marketing opportunities for

retention of businesses depending on the potential competitiveness of the product presented.

To estimate the competitive potential of grapes expressed through the system of economic efficiency indicators, the statistical groups were divided into 6 groups of all firms surveyed, which we considered to be appointed as follows:

Group I: 0.61 and more (business leaders) - 11.5%; Group II: 0.51 to 0.60 (business outlook) - 15.4%; Group III: 0.41 to 0.50 (average efficiency) - 21.5%; Group IV: 0.31 to 0.40 (moderate efficiency) - 24.6%; Group V: 0.30 and lower (low efficiency) - 13.2%; Group VI: profitable enterprises - 13.8% (Figure 1).

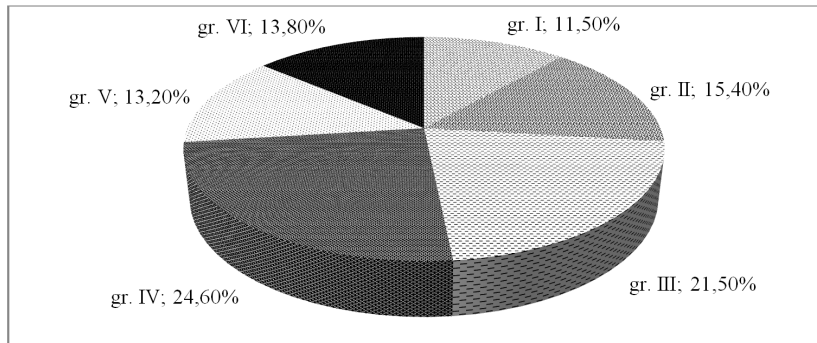


Fig. 1. Groups of Enterprises Development South and Gagauzia after multicriterial

Source: calculated by the author.

To determine the economic efficiency of the whole global agricultural production besides the traditional indicators and proposed average coefficient is calculated on the basis of multi-criteria main indicators characterizing efficiency using the following equation:

- For profitable businesses:

$$\bar{C}_{rentab} = \frac{\frac{R_{i.a.}}{R_{opt.a.}} + \frac{R_{i.}}{R_{opt.}} + \frac{R_{i.m.f.}}{R_{opt.m.f.}} + \frac{R_{i.c.p.}}{R_{opt.c.p.}} + \frac{P_{i.a.}}{P_{opt.a.}} + \frac{P_{i.c.p.}}{P_{opt.c.p.}} + \frac{R_i}{R_{opt}}}{n} \quad (3)$$

- For unprofitable businesses:

$$\bar{C}_{nerentab} = \frac{\frac{R_{i.a.}}{R_{opt.a.}} + \frac{R_{i.}}{R_{opt.}} + \frac{R_{i.m.f.}}{R_{opt.m.f.}} + \frac{R_{i.c.p.}}{R_{opt.c.p.}} + \frac{P_{opt.a.}}{P_{o.a.}} + \frac{P_{opt.c.p.}}{P_{i.c.p.}} + \frac{R_{opt}}{R_i}}{n} \quad (4)$$

$\bar{C}$  – multi-criteria environmental coefficient of economic efficiency and global agricultural production units;

$R_{i.a.}, R_{opt_{i.a.}}$  – yield agricultural land (MDL) for the unit and the unit with optimal frontier level (standard);

$R_{i_l}, R_{opt_{i_l}}$  – the average labor productivity of a worker annually (MDL) for the unit and the unit with optimal frontier level (standard);

$R_{i.m.f.}, R_{opt_{i.m.f.}}$  – the yield of agricultural productive fixed assets (MDL) for the unit and the unit with optimal frontier level (standard);

$R_{i.c.p.}, R_{opt_{i.c.p.}}$  – yield production costs for the unit and optimal frontier level unit (standard);

$P_{i.a.}, P_{opt_{i.a.}}$  – profits (losses) from the sale of agricultural production from 1 ha of agricultural land and drive units for optimal border level (standard);

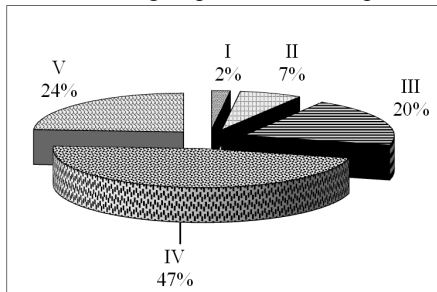
$P_{i.c.p.}, P_{opt_{i.c.p.}}$  – profits (losses) from the sale of agricultural production to 1 leu and unit production costs and optimal frontier level unit (standard);

$R_i, R_{opt}$  – level of profitability (unprofitable) for the unit and the unit with optimal frontier level (standard);

n - number of characteristics;

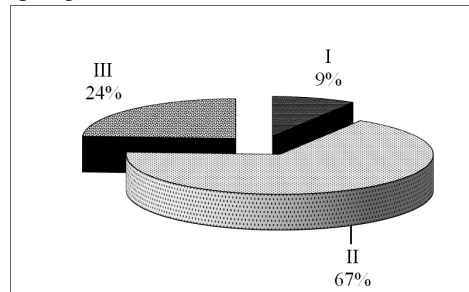
i – the number of units surveyed the crowd.

Based on the data of 894 agricultural enterprises in Moldova it was estimated economic efficiency by the system of indicators. Under the proposed methodology indices were calculated individually for each feature, based on average coefficients which were determined multi-criteria assessment of the effectiveness of each enterprise. Based on average salary levels Multicriterial businesses were arranged in descending order and appreciated the place it occupies in the competitive environment hierarchical organization from one enterprise to another. Next, using the statistical groups, profitable enterprises were distributed in groups V and the unprofitable in groups III.



**Companies profitable**

- I gr. - Business leaders
- II gr. - Business outlook
- III gr. - Enterprises with average efficiency
- IV gr. - Enterprises with moderate efficiency
- V gr. - Enterprises with low efficiency



**Companies unprofitable**

- I gr. - Enterprises with prospects of becoming profitable
- II gr. - Profitable enterprises with average
- III gr. - Profitable enterprises with high level

Fig. 2. Distribution of agricultural enterprises in Moldova in groups after multi-criteria of economic efficiency coefficient of global agricultural production

Source: calculated by the author on the initial data base from agricultural enterprises.

Next, using the statistical groups, profitable enterprises were distributed in groups V and the unprofitable - in III group (Figure 2).

Distribution of agricultural enterprises into groups according to the range limits show that 15.4% of the total were negative return (Figure 2). And the cost is shared with only a 2% share in the group-leading companies, 7% in group enterprises perspective, 20% in the average level of efficiency, and the rest - 71% efficient businesses an moderate and low.

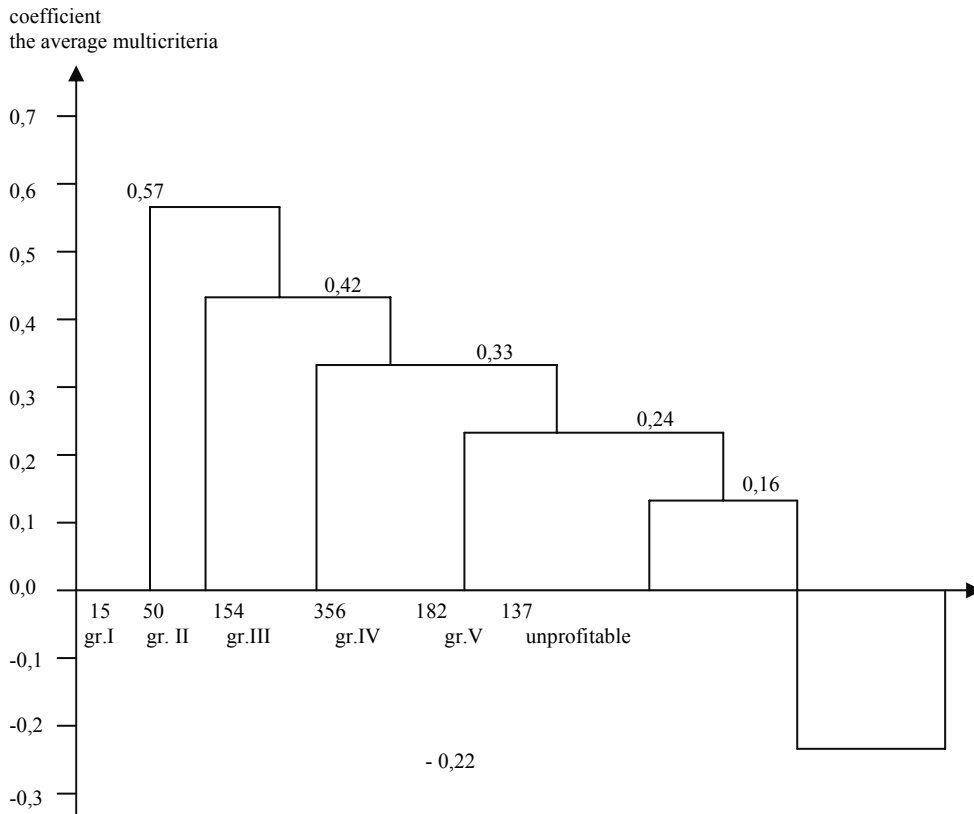


Fig. 3. Diagram vertical distance agribusinesses to leading enterprises groups

Source: Calculated by the author on the initial data base from agricultural enterprises.

Figure 3 shows that individual indices depending on concrete indicators are at different distances relative to the optimal level, and group V relative deviation is 0.41 lower than in Group I. According to the results obtained in the first group with membership from 15 companies producției indicators of overall economic efficiency are the highest. For example, Ltd. "Codru ST" r. Strășeni, ordering 984 hectares of agricultural land, a herd of workers and average annual value of fixed assets 146 persons for agricultural production of 7.041 million lei, with the potential for high yields Resources obtained revenues of 9.944 million lei, gross profit amounted to 5.981 million lei, and the level of profitability of 113.25%, which allowed him to be ranked first in the hierarchy of the 894 businesses surveyed competitive.

Table 1. Grouping of the agricultural enterprises in Moldova after the average coefficient of efficiency economical multi-criteria global agricultural production (relative to the optimal level)

Groups of undertakings after multicriteria average coefficient of economic efficiency of global agricultural production (optimal frontier)	The number of enterprises	This weighted average of economic efficiency of global agricultural produției	Global agricultural production value, calculated in lei:				Profit from sale of agricultural production, lei calculated at:		Level of profitability, %
			1 ha of agricultural land	1 average annual worker	1 leu value of fixed assets	1 leu production costs	1 ha of agricultural land	1 leu production costs	
Rentable									
I. 0,51 and more (leaders)	15	0,57	5235,6	40828,0	0,92	1,08	3239,0	0,67	74,8
II. 0,41 – 0,50 (business outlook)	50	0,42	4524,3	32277,2	0,91	1,15	1638,3	0,42	53,4
III. 0,31 – 0,40 (the average level of efficiency)	154	0,33	3907,2	32244,2	1,34	1,02	965,7	0,25	29,3
IV. 0,21 – 0,30 (moderate efficiency)	356	0,24	3101,9	25937,0	0,81	0,89	477,1	0,14	16,7
V. mai puțin de 0,2 (low efficiency)	182	0,16	2184,9	16156,3	0,44	0,82	150,9	0,06	6,61
Total average cost on businesses	757	0,25	3212,5	25905,3	0,82	0,93	624,4	0,18	21,7
Unprofitable									
I. 0,41 and more	33	0,42	2112,4	28765,8	2,36	0,89	-42,4	-0,02	-1,63
II. 0,21 – 0,40	92	0,24	2143,2	18158,1	0,58	0,80	-206,5	-0,08	-8,7
III. 0,2 and less	12	0,15	1065,7	10006,8	0,88	0,70	-318,5	-0,21	-21,8
Total, on average unprofitable businesses	137	0,22	1815,2	16217	0,67	0,78	-229,4	-0,10	-10,9
TOTAL	894	X	3045,3	24846,6	0,81	0,92	522,2	0,16	18,7

Source: calculated by the author.



Businesses of I degree have a high competitive potential and their competitive abilities leading agricultural enterprises are defined in Table 1. It should be mentioned that these companies are leaders in Moldova and own performance and very high level of competitiveness.

The research results allow us to demonstrate the advantages of the proposed methodology for calculating the synthetic indicator (full) efficiency used along with traditional indicators of competitive economy, which are:

- This methodology is based on complex multi-criteria assessment approach complex system of economic efficiency of production;
- Multi-criteria assessment is based on the weighted average method of comparison and take into account the actual results of all businesses;
- Estimate is made based on public data of specialized forms of enterprises surveyed, which are used in traditional practice of assessment of effectiveness;
- Does not restrict the number of indicators years, businesses etc.
- Corresponds to the existing practice of competitive economy, where each producer aims to surpass its competitors in all positions (indicators) that characterizes the competitiveness and economic efficiency of production.
- Between economic efficiency indicators calculated in the hierarchy of competitive businesses there is a reciprocal link, are harmonized, have an increase (decrease) consecutive and are comparable.
- Estimate the full economic efficiency enables to identify the location of all agricultural units after the economic efficiency in the hierarchy studied compared with optimal frontier (benchmark).
- Dividing the group gives opportunity to highlight the types of units: leaders, business outlook, with the average level of efficiency, with moderate efficiency, low efficiency, unprofitable and place each undertaking within the group.
- Give the opportunity to identify the results according to the factors highlighted by types of businesses.
- Gives opportunity to identify funds for increasing economic efficiency compared to optimal levels and levels compared with previous groups.
- Comparability of indicators is kept whole, because they are standardized optimal frontier level (standard).
- Is a reliable method for measuring the increase in business competitiveness and production efficiency.

## Conclusion

- Agriculture in Moldova is characterized by low efficiency and does not create conditions for extended reproduction. Agriculture in Moldova is characterized by low efficiency and does not create conditions for extended reproduction.
- Number of enterprises in the first and second groups (leaders and perspective) is only 65 units (9.0%), from Gk. III - 154 (20.0%) and of the groups IV and V taken together - 538 (71.0%). The situation became possible primarily because of lack and inefficient use of resources potential, competitive level low priority growth to increased costs of selling prices of agricultural products, insufficient state subsidies, reduced implementation of

technical progress and fertilizers etc. This means that within the agricultural sector is a process of differentiation.

- In reality, we believe that it creates four types of agricultural economics, which are dispersed and poorly linked:
  - *a progressive economy* - a small number of enterprises (9.0%), stable working and practicing a breeding enlarged;
  - *a balanced economy* - some 20% of businesses have extended breeding with fewer opportunities;
  - *a weak economy* - a considerable number of companies (about 71%) is operating profit, but provides a simple reproduction;
  - *a stagnant economy* - profitable enterprises with weak material base, where the debts exceed the value of assets and provides a breeding regressive.

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