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STUDY REGARDING THE OPTIMAL DIMENSION OF THE S.C. AGROZOOTEHNICAL FARM S.A. WITH THE HELP OF STATISTICAL-MATHEMATICAL METHODS

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Abstract

An important problem, on which production and economic results depend for a long time, is the size of agricultural exploitations. The use of statistical methods, among which the one known as the "statistical method of studying the mass experience" or simply the "method of grouping", is the most widespread [10] in order to determine the optimum size of agricultural exploitations is based on the concept of statistical correlation, that can be attributed to the links between potential indicators (factorial or independent variables) and results and economic efficiency indicators (resultant or dependent variables) of an agricultural holding. The calculations show that the managers of the exploitations from the forth interval have made greater efforts to match the highest level of turnover and profit. How many? As far as the optimal number is concerned, it should be taken into account that the cost of production is more important to producers, as the sales price is formed under the impulse of the demand-supply ratio. In conclusion, the present study sets the optimal range related to the area of 3,801ha – 4,400ha and the optimal breeding females: 686 heads.

Key words**:** *agricultural exploitation, optimal dimension, production*

INTRODUCTION

Lately, determining the optimal size of the agricultural exploitation and its subdivisions has been a major concern for both economic research and agricultural organization, as well as for agricultural practice.

In this context, the problems related to the microeconomic optimum have outlined themselves methodologically, by several methods and procedures. [4]

For example: The monographic method, also referred to as "the monographic study of the experience of the leading households", "the study of the experience of the leading households" or "the generalization of the experience of the leading households" consists in studying the typical production units for the profile and the respective area, with the best results in production. [7]

The company's main activity is the production, trade and industrialization of agrotechnological products.

The company operates in average 4,000 ha arable land per year, out of which 3,000 ha are irrigated, and is also engaged in raising dairy cattle ranging around 1,450 heads of cattle, of which 800 heads are breeding females.

The land that the company exploits is the property of the company, an area of 1,140 ha, and the difference is leased arable land that is owned by natural persons adjacent to the company.

The company produces on the arable land area cereals and technical plants as well as feeds necessary for the livestock sector. In livestock production, the company manufactures cow's milk and fattens cattle.

The initial social capital of 167,000 lei and 167 shares with a face value of 1,000 lei each during the activity underwent a series of increases in total value of 6,390,623 lei and decreases of 1,543,223 lei. At the moment of research, the social capital of the company being 5,015,000 lei.

The activity is organized in production farms and specialized service sectors of the production farms. Thus, the company has the following subunits: - 3 farms with vegetal profile; - 1 dairy cattle breeding farm; - the

servicing sector with repair profile of agricultural machinery and execution of services specific for agriculture towards the farms of the company; - the supply, distribution, transport sector, which aims at providing the necessary material for the production process, distribution of the products obtained by the farms and managing the means of transport necessary for the above activities; - the accounting department and a number of 219 employees, out of which 184 permanent employees.

MATERIALS AND METHODS

The method of parallel interdependent series consists in the appreciation of the link between two or more ordered features in the form of parallel strings. [2]
In order to determine the optimal dimension of agricultural exploitations (variable xi), the correlation with the yij values will be made, which represent the results and efficiency indicators.
Applying the method implies the existence of a data bank on: a certain number of agricultural exploitations, the surface for each exploitation, the levels of the results indicators and the efficiency that characterizes their activity. [3]
The method starts by grouping the units according to size ranges, for which it is recommended to use H.D. Sturges' relationship [6]:

$$h = \frac{x_{max} - x_{min}}{K}$$

where:
x max, x min – the maximum, respectively the minimum surface, of the units taken under study;
K = 1+3.322 log n – represents the number according to groups in which the „n" agricultural units split.
In order to carry out the grouping of exploitations it is necessary to meet the following requirements in advance:
- the exploitations should have the same specialization and have the same production conditions;
- each group should include a certain number of agricultural exploitations so that the results are significant;
- the grouping interval should ensure differences in the level of outcome and efficiency indicators. [1]
Having the group units (K), the partial averages of each economic efficiency and results indicator will be calculated according to the formula:

$$\bar{y}_i = \frac{\sum_{i=1}^{nj} i_j}{n_j}$$

$\bar{y}_i$ – represents the average of the indicator for class j;
j = 1,2,3, . . ., K
y_{ij} – the levels of the indicators according to the nj units from group j;
n_j – the number of units from each group;
n – the total number of units;

$$\boldsymbol{n} = \sum_{\boldsymbol{i=1}}^{\text{nj}} \text{nj}$$

The optimal size range will be the one that corresponds to the maximum level of partial averages for the direct and/or minimum for the indirect efficiency and results indicators. [5]
The study of the dimension at S.C Agrozootechnical Farm S.A. was conducted based on the information obtained through own research, from the practical activity of several exploitations.

RESULTS AND DISCUSSIONS

Following the information processing, the resulting data are as follows:
n = 15
x_{max} = 5,000
x_{min} = 2,000
So:

$$h = \frac{5{,}000 - 2{,}000}{1 - 3.322 \log 15} = 600 \text{ ha}$$

Tabel 1. Results and efficiency indicators of agricultural exploitations of different sizes

Nr.	**Dimension interval (ha) xi**	**Nr. of units**	**Results and economic efficiency indicators**				
			Turnover (thousand lei)	Expenses related to the turnover (thousand lei)	Labor productivity (thousand lei/pers)	Expenses per 1,000 lei turnover	Profit
1	2,000-2,600	2	15,642	14,164	252,600	905.5	1,478
2	2,601-3,200	4	29,850	25,819	304,525	864.9	4,031
3	3,201-3,800	4	37,000	32,500	379,779	878.3	4,500
4	**3,801-4,400**	3	42,875	36,536.5	415,000	852.1	6,338.5
5	4,401-5,000	2	32,000	28,880	325,900	902.5	3,120
Total		15					

Source: own calculation.

As can be seen, interval nr. 4 is optimal because we have maximum levels for direct indicators (turnover, labor productivity, profit) and minimum levels for indirect indicators (expenses per 1,000 lei turnover).
However, in the interval nr. 4, the expenses related to the turnover represent a maximum level (the method has limitations in application), which shows that the managers of the exploitations in this interval have made greater efforts corresponding to the highest level of turnover and profit.

The regression method - studying the dimension and setting its optimum level can be done by resorting to the regression method that is based on the use of the production function.
The production function expresses the functional relationship between a dependent variable (production and economic indicators) and an independent variable (surface or livestock) in the form: [8]

$y = f(x)$

In order to study the size using the regression function, you need to go through the following steps:
- the graphical representation of empirical data in order to find out the types of function that characterize the phenomenon (the link between the two variables); [9]
- determining, using the smallest squares method, the coefficients of the production function;
- finding the maximum or minimum point of the function by calculating its derivative I and the value of the independent variable;
- determining the value of the dependent variable by introducing the value of the independent variable in the concrete form of the function.

The study aims to determine the dairy breeding females at S.C. Agrozootechnical Farm S.A. through the afore mentioned method, using information retrieved from farms having the same activity.
The production function is a statistical method, when it is applied, we proceed as in the previous case when establishing the group interval:

$$h = \frac{950 - 200}{1 - 3.322\log 15} = 150 \text{ heads}$$

Table 2. Indicators of the different agricultural exploitations studied

Nr.	**Heads dimension interval x_i**	**Nr. of units**	**Average production (Q) (l/head y_1)**	**Cost/liter milk (lei/l) y_2**	**Cost/liter milk (RON/l) y_2**
1	200-350	4	3,800	4,100	0.41
2	351-500	5	4,500	3,900	0.39
3	501-650	3	5,200	3,300	0.33
4	651-800	1	4,900	3,500	0.35
5	801-950	2	4,100	3,600	0.36
Total		15			

Source: own calculation.

Analysis of the correlation between livestock and average production on fed cow

$y = a+bx+cx^2$

$$na + b\Sigma x + c\Sigma x^2 = \Sigma y$$
$$a\Sigma x + b\Sigma x^2 + c\Sigma x^3 = \Sigma xy$$
$$a\Sigma x^2 + b\Sigma x^3 + c\Sigma x^4 = \Sigma x^2 y$$

$n = 5$

Table 3: Correlation between livestock and average production on fed cow

	x	**y**	**x^2**	**x^3**	**x^4**	**xy**	**x^2y**
	275	3,800	75,625	20,796,875	5,719,140,625	1,045,000	287,375,000
	425	4,500	180,625	76,765,625	32,625,390,625	1,912,500	812,812,500
	575	5,200	330,625	190,109,375	109,312,890,625	2,990,000	1,719,250,000
	725	4,900	525,625	181,078,125	276,281,640,625	3,552,500	2,575,562,500
	875	4,100	765,625	669,921,875	586,181,640,625	3,587,500	3,139,062,500
Σ	2,875	22,500	1,878,125	1,338,671,875	1,010,120,703,125	13,087,500	8,534,062,500

Source: own calculation.

5a + 2,875 b + 1,78,125 c = 22,500
2,875 a + 1,878,125 b + 1,338,671,875 c =
= 13,132,500
1,878,125 a + 1,338, 671,875 b +
+ 1,010,120,703,125 = 8,592,562,500

$y = 998.73 + 13.787\ x - 0.012\ x^2$
$y' = 0 \Rightarrow 13.787 - 0.024\ x = 0$

x = 574 optimum heads of animals which determine the highest level of animal production.
$y = 998,73 + 13,787 \bullet 574 - 0,012 \bullet 574^2$
y_{MT} = 4,959 l/animal head

Analysis of the correlation between livestock and the production cost per liter of milk.

Table 4: The correlation between livestock and the cost of production per liter of milk

	X	y (lei/l)	y (RON/l)	x2	x3	x4	xy	x2y
	275	4,100	0.41	75,625	20,796,875	5,719,140,625	1,127,500	310,062,500
	425	3,900	0.39	180,625	76,765,625	32,625,390,625	1,657,500	704,437,500
	575	3,300	0.33	330,625	190,109,375	109,312,890,625	1,897,500	1,091,062,500
	725	3,500	0.35	525,625	181,078,125	276,281,640,625	2,537,500	1,839,687,500
	875	3,600	0.36	765,625	669,921,875	586,181,640,625	3,150,000	2,756,250,000
Σ	2,875	18,400	1.84	1,878,125	1,338,671,875	1,010,120,703,125	10,370,000	6,701,500,000

Source: own calculation.

5a + 2,875 b + 1,878,125 c = 18,400
2,875 a + 1,878,125 b + 1,338,671,875 c =
10,370,000
1,878,125 a + 1,338,671,875 b + 1,010,120
703,125 c =6,701,500,000

$y = 5,486.11 - 6.044\ x + 0.0044x^2$
$y' = 0 \Rightarrow -6,.44 + 0.0088x = 0$
x = 686 heads
$y = 5,486.11 - 6.044 \bullet 686 + 0.0044 \bullet 686^2$
y = 3,410.55 lei/ liter
y = 0.34 RON/ liter

The problem of choosing the optimal solution appears: how many? To this end, it is to be considered that the production cost is more important to producers, as the sales price is formed under the impulse of the demand-supply ratio.

CONCLUSIONS

S.C. Agrozootechnical Farm S.A. is in the optimal range regarding surface (3,801-4,400) because it exploits a surface of 4,000 ha.
From an economic point of view, we can say that the optimal female breeding stock is 686 heads, but from an ecological point of view we could say that the optimal female breeding stock is 574 heads because the production is maximum, and the ecological pressure will be lower due to a smaller flock.

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