BAZA METODOLOGICĂ PENTRU CALCULAREA DIMENSIUNILOR OPTIME ALE ORGANIZAȚIILOR AGRICOLE

Alexey SHAMIN, drd.
Anatoly SHAMIN, dr., profesor, Nijni Novgorod Institutul de Stat de Inginerie şi Economie, Rusia

Articolul prezintă diverse abordări ale unui şir de autori cu privire la determinarea dimensiunii optime a organizaţiilor agricole şi natura acestora. Există diferite metode care au fost utilizate în timpul cercetării, inclusiv statistică, monografică, constructivă şi altele. Articolul prezintă, de asemenea, contribuţia oamenilor de stiinţa şi cercetatorile ce vizează soluţionarea problemelor de calculare a dimensiunilor optime în întreprinderile agricole, precum şi criteriile de eficienţă propuse de metodele selectate.

Cuvinte cheie. *agricultură, dimensiune optimă, eficienţa, tehnica, întreprindere, cercetare.*

METHODOLOGICAL BASIS FOR CALCULATING THE OPTIMAL SIZES OF AGRICULTURAL ORGANIZATIONS

Alexey SHAMIN, PhD Student
Anatoly SHAMIN, PhD, Professor, Nizhny Novgorod State Engineering and Economic Institute, Russia

The article presents different approaches of a number of authors how to determine the optimal size of agricultural organizations and their nature. There are different methods that were used while researching, including statistical, monographic, constructive and others. The article also presents the contribution of various scientists and researchers in solving optimization problems with the sizes of enterprises in agriculture, as well as proposed efficiency criteria of chosen methods.

Keywords. *Agriculture, optimal size, efficiency, technique, enterprise, research.*

JEL Classification: O10, O14, Q1, Q16, Q19

First, the problem of determining the optimal size of agricultural organizations became involved in the early XIX century by German scientist J. Thünen. He revealed the influence of farm size on the efficiency by calculating the dependence of the size of the rent on the distance between the farm and the barton, dividing all the works made in the household into four classes, depending on their impact on farm transport (Figure 1).

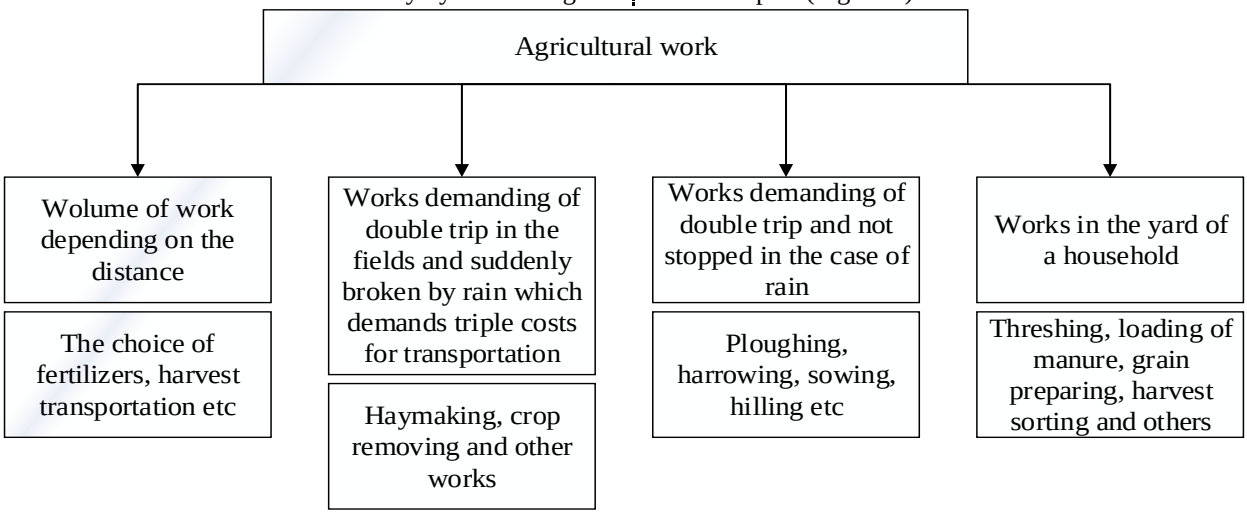

Fig.1. Classes of works affecting the efficiency of agricultural production according to J. Thünen

To determine the losses of these works J. Thünen used the differentiated approach. For the works of first class costs were calculated with costs for inner farm transport, the works of second and third class the costs were calculated from the amount of lost work time for employees moving from the house to the place of work and back. The fourth class works do not depend on the distance, they are held in the courtyard of the barton. On this basis he made the table of falling rents depending on the distance of the field from the house for the first time applying the indicator "average distance between fields and the barton".

In 1839 Monten repeated calculations of Thünen in modified form. He took the value of the average distance from the homestead fields as a basis and calculated its impact on the value of agricultural work [4].

In 1904 Werner expresses the idea that high-yield agriculture is possible with normal distance between fields and barton must be no more than 1000 meters if the land is good, and on the worst land – 750 meters. Thus, he did not describe the method of calculating in his works [7].

Making conclusions about the research of German scientists in the early XIX century, we can obtain that they first started the calculation of the size limit of the household based on manual and horse-drawn labor. They applied highly original methods of calculation, which shows that agricultural organizations have some size limits when agricultural production becomes not effective.

The most important method of calculating the optimal size of a household of the farm in early XX century is the research of A.V. Chayanovsky in which he defined the problem of finding the optimal size of the area in which, ceteris paribus , the cost of products would be lower [2, p. 12]. He divided all the elements of cost into three groups:

- Elements, decreasing while the growth of the household (cost of machine using, use of buildings, and other administrative costs);
- Elements, increasing while the growth of the household (costs for inner transport and farm losses from low intensity of control per a unit of the product);
- Elements which do not depend on the size of the farm (the cost of seeds, fertilizers, handling, etc.).

According to Chayanovsky to find the optimal size, you need to find the point of low-cost production after summarizing of all three groups of elements.

Nowadays, the question of the theory of optimum size based on the average distance between fields and the barton received further research and development. So, K. I. Sazonov professor who, in addition to Chayanovsky ring method for determining the average distance, offered another one based on dividing the area of farms into triangles with the barton in one of its corners. This method is more time-consuming than Chayanovsky one, but made possible to quickly obtain the final result thanks to the applications developed by the author. Sazonov suggested not only need to calculate the geometric mean of the distance, but also take into account the practical way on the roads.

One of the most important works about the definition of methods and techniques of developing the optimal farm size was work made by the Scientific and Research Institute of Agricultural Economy, the Institute of Economics of the Academy of Sciences of the USSR and the republican institutions of the economy, and agriculture organizations. The essence of the proposed methods and techniques is in the following.

In determining the optimal size of collective farms, inner the farm units for the perspective they used different methods, including statistical, monographic, constructive and others.

The statistical method used in the beginning of the study to assess the size of the existing collective farms and farm units , which were analyzed with regard to their placement and production profile. They determined then rational management of the size. At the final stage was made an attempt to calculate the optimal sample size of collective farms on the land.

Statistical method studied the effect of individual factors on the size of the collective farms and the efficiency of agricultural production (capital-labor level, intensity etc.), as well as the size of the branches of collective farms and their economic efficiency. Then by grouping farms they revealed the connection between the size of the household and ground, products, fund of livestock and its results. Through the combination grouping they revealed rational collective farms sizes in groups of value of gross agricultural output per 100 hectares of agricultural land, as well as subgroups on the profitability of agriculture (production costs of 1000 rubles of gross output).

Rational sizes of land use are represented by farms included in the highest group on the level of production, and in it the highest subgroup on its profitability.

In order to verify the identified rational dimensions of collective farms on areas of the country, taking into account the direction of farm production in the final stage of the study, the same method of statistical grouping was used. In this regard, farms with rational land-use management analyzed before, once again were subjected to statistical processing. In connection with which they were divided into three groups: the first consisted of households having rational sizes, the second – the collective farms, which dimensions were higher than rational, and the third – the collective farms with sizes less than rational. Then each group was divided into three subgroups according to the level of agricultural production and the collective farms, having rational dimensions are subdivided into subgroups according to profitability. Using statistical method on mass materials the relationship between the size of land and results of collective farms economic activity was quite reliably identified.

To obtain more reliable results, the authors additionally used other methods, including the study of collective farms by monographic research method. In this case, the best groups and subgroups were selected only in those farms in which the level of agricultural production and profitability were higher than the average for this subgroup. Monographic method of research included a survey of selected farm for several years.

Method of variant calculations was mainly used to establish the optimum dimensions for the future of livestock farms and production teams. Its essence is to find the size unit in which production costs as well as costs inner transportation varying depending on the size of units is the smallest.

In variant calculations assuming variable costs all other conditions are considered equal except the indicator that characterizes the size of units (the number of livestock on the farm, arable land in the production team). The minimum amount of variable costs per head of livestock or livestock products unit and unit of land area indicate the optimal size. Optimal size obtained by the sum of the minimum variable costs is recommended to be evaluated by its economic efficiency, such as payback period of capital investment or capital productivity.

The advantages of the method of variants consists in the fact that it requires strict measurement of the total cost, depending on the size of a household, it allows to compare their sizes and choose the most effective one. However, it has its own significant drawbacks: first, it is very time-consuming, and secondly, allows such a large convention, such as equality of other conditions, except for the size of the units, and thirdly, it can be used essentially only in determining the optimum size of different departments in such farms, a single household which have. Calculation and constructive method is used for the perspective forecasts for a household as a whole.

To do this, basing on statistical and monographic method the most advanced household is selected having rational indicators of the land and two indicators which are stable in dynamics for several years: the level of agricultural production (gross production output by 100 hectares of agricultural land) and profitability (the amount of agricultural costs per 1000 rubles of gross agricultural output). On the example of selected farms, the production and organizational structure is developed for the future, which includes reasonable specializations, combination of main and additional commodity sectors, the number and size of farm units, their location in the territory, perspective volume and level of agricultural production in the future, based on the actual management capabilities to improve crop yields and livestock productivity.

Chronography method is used in the last stage of the study as a part of the calculation and constructive method for estimating the number of farm departments, which can be operated and the number of which depends on the maximum size of land. Using chronograph method the assessment of management factor was led by control of time spent by managers and specialists dealing with various problems and decisions. It offered then the rational structure of management.

Mathematical methods are used mainly in the final stage of the study to assess the conclusions made using statistical, monographic, variant and calculation and constructive methods. These methods, however, can also be used at the initial stage of the study, while setting the quantitative relationship between the size of farms in the area of agricultural land and economic results expressed as a level of agricultural production. To estimate the size of farms curvilinear correlation is applied, wherein except the level of agricultural production, it can be measured by the output of gross agricultural production, depending on the profile of the household per unit of current production costs. The relationship between the size of arable land and profitability of agricultural production (gross output of agriculture production per ruble of production costs) in agricultural farms is solved by a parabola of the second order equation: $yx=a+bx+cx^2$. Value of the unknown parameters a, b and c is found by solving a system of three linear equations:

$$I \sum y=an+b\sum x+c\sum x^2$$
$$II \sum xy=a\sum x+b\sum x^2+c\sum x^3$$
$$III \sum x^2y=a\sum x^2+b\sum x^3+c\sum x^4$$

Using the method of curvilinear correlation it is also possible to determine the correlation coefficient characterizing the closeness of the relationship between the results of agricultural production and its main factor – the size of the land.

To determine the level of control of the farm authors used sociological research methods and survey questionnaires with farm workers.

Authors concluded that each of the methods, taken separately, has its advantages and disadvantages. For a more accurate assessment it is not advisable to use one method, but use all of them, assigning each a definite place in the structure of the study [8, p. 33-52].

At the same time, scientific research teams in the Soviet Union also were working to determine the optimum size of the agricultural organizations. M. A. Gendelman, M. D. Spector and E. D. Tikhomirov in Kazakhstan, came to the conclusion that at the same level of specialization and intensification the same impact on farm management have dimensions of land, especially farm land. For grain farms they propose to use the arable land area as an indicator of the optimum size [9].

Basing on studies led in Uzbekistan K. I. Lapkin proposed an overall economic optimality criterion to estimate the size of the household – maximum production at least costs. So, for the study of the prevailing collective and state farms sizes author applied as indicators:

- the use of land as the basic means of production – the output of gross production per 100 hectares of irrigated land and farmlands;
- the use of productive assets - output per 1,000 rubles of all fixed assets;
- gross production output for 1000 rubles of all direct and indirect costs of production;
- labor productivity – gross production output per worker employed in social production.

All these parameters are summarized in the cost and profitability of enterprises. This significantly varies not only the level but also the production cost structure [10].

In connection with the creation of off-farm enterprises and agricultural and industrial complexes, research team led by professor D. F. Vermel gave recommendations for determining the optimal size of these companies, which proposed the basic methodological principles of optimizing the size of livestock complexes for the production of beef, milk, and the optimum size of the pig, sheep enterprise, poultry farms, off-farm seed companies specializing in the production of seeds of grain crops and perennial grasses, greenhouse complexes and associations to grow vegetables indoors, enterprises in the sectors of horticulture and viticulture, the recommendations were given on the horizontal integration of the creation of off-farm enterprises and associations [11].

In the late eighties – early nineties there is a need to return to the development of methodology for determining the optimal size of land farms. A. E. Shamin with I. A. Altukhov proposed an original methodology to calculate the optimum dimensions of land used in agricultural enterprises, which consisted of the following. At the first stage the authors established a rational method of multidimensional (cluster) analysis by using seven indicators: the total area of arable land in agriculture and agricultural area in total per employee, the basic production assets, cash proceeds, and profit per hectare of arable land.

They set that the total area of arable land (agricultural land) in the houseold and its size per employee are key indicators of firm size and in combination with the basic production assets they give the final result – profit and commercial products [5, p. 65-72].

In 2012, I. V. Lobanova proposed the method for determining the structure of the productive resources of agricultural enterprises based on the use of economic-mathematical model of optimization of production resources.

The model is based on the production function, which describes the value of the factors of production and allows determining the reserve to increase the intensity of use of these resources in the future. The proposed method uses a non-linear model in the form of a power function and a system of indicators reflecting the state of the external and internal environment within the study period, the crop area or livestock, salary of employees engaged in agricultural production with charges. Thus, the proposed methodology allows determining the optimal value of the intensity of use of productive resources by products for specific agricultural enterprise on the planning horizon [6, p. 20].

Referinţe bibliografice / References

1. ШАМИН, А.Е. *Оптимизация землепользования сельскохозяйственных организаций*. Нижний Новгород, 1994. 114 с.
2. ШАЯНОВ, А.В. *Оптимальный размер сельскохозяйственных предприятий*. Москва: Новая деревня, 1928. 92 с.
3. НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ ЭКОНОМИКИ СЕЛЬСКОГО ХОЗЯЙСТВА. *Предложения по оптимальным размерам межхозяйственных предприятий и объединений*. Москва, 1965. 126 с.
4. Montenon "Anleitung zur landwirtschaftl. Veranschlagung". Berlin, 1839.
5. АЛТУХОВ, И.А., ШАМИН, А.Е. *Новый аграрный строй в России*. Нижний Новгород: Нижегородполитграф, 1996. 281 с.
6. ЛОБАНОВА, И.В. *Организационно-экономическое обоснование объемов производства сельскохозяйственной продукции в аграрных предприятиях на основе оптимального использования ресурсов* : автореферат диссертации на соискание ученой степени кандидата экономических наук. Белорусская государственная сельскохозяйственная академия. Горки, 2012. 26 с.
7. WERNER, H. *Zeitgemaszer Landwirtschaftsbetrieb*. Berlin, 1909. 80 p.

Recomandat spre publicare: 03.03.2014