SUMMARY

of the doctoral thesis entitled:

CONTRIBUTIONS TO ESTABLISHING THE ECONOMIC DIMENSION OF AGRICULTURAL HOLDINGS. CASE STUDY, DÂMBOVIȚA COUNTY.

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KEYWORDS : the agricultural holding economic dimension, sustainable agriculture, Cobb Douglas functions, linear programming model, South-Muntenia Region, Dâmbovița County

The food problem is one of the most pressing challenges that humanity must find a solution to in the current conditions of sharp population growth and climate changes that affect food production. The need to establish that the development directions of agriculture fall equally to scientific research, agricultural education and of course agricultural policies promoted at the national, European Union and world level. It is considered that a review of the entire Common Agricultural Policy is necessary, because, in its current form, it leads to an industrialization that leaves no room for the development of the peasantry.

This doctoral thesis aims to carry out an analysis by using some methods and indicators for the optimization of agricultural holdings according to the economic dimension in order to practice environmentally friendly agriculture, ensuring agricultural productions that support the normal nutrition of the population while respecting the economic and social interest of farmers. It can be stated that the technological production of recent years has resulted in the continuous increase in the size and physical size of agricultural holdings, with a negative impact on the environment and on rural communities.

Agricultural research seeks to find a size and dimension of the agricultural holding that allows a decent and secure income, that allows the continuity of the holding, but at the same time ensures the sustainability of the environment.

Therefore, the optimization of the size of agricultural holdings aims to use with maximum efficiency the environmental, economic and social conditions of the agricultural unit for the development of a profitable activity.

The thesis has a structure consisting of 5 chapters, and also includes conclusions, bibliography and appendices.

Chapter I , entitled "***Research on the definition of the agricultural holdings economic dimension***" addresses the general aspects of the evolution of the size concept of the agricultural holding according to different criteria: production, economic and environmental results.

Over time, ways to increase the size of the agricultural holding were constantly sought. Thus, in this research, some measures used to stimulate the growth of the physical dimension have been highlighted, such as the registration of property rights in the Land Register, the travel annuity, the granting of financial aid for young farmers, the stimulation of the association of small agricultural producers for the mechanized performance of agricultural works and the practice employment, modernization of animal husbandry, storage and marketing of products and other forms of cooperation; establishing farms that produce in an ecological system, etc.

This chapter presents the methods of classifying the size of the agricultural holding, namely: the method of assessing the size through physical indicators (agricultural land area, number of workers, livestock of cattle, dairy cows, sheep, pigs, birds, number of bee families), the size classification method by conventional value indicators (gross margin, standard production), the scoring method for evaluating the sustainability of the agricultural farm.

Also, from the specialized literature it emerged the impact of the size increase in the agricultural holding (impact on the environment, technology, increase in production, increase in labor consumption, credit), the main problems faced by agriculture caused by the increase in size (effects on human health and the environment).

Another very important aspect studied in the first chapter is the link between the size and sustainability of the agricultural holding, the conclusion being that the economic dimension and the sustainable agriculture of the agricultural holdings must intersect in practicing agricultural technologies without degrading the environment and without reducing economic viability, in the meaning of not compromising the interests of future generations.

The chapter continues with an analysis of data taken from international and national statistics to determine the evolution of agricultural holdings according to the physical and economic dimension (according to the value of standard agricultural production).

It is thus found that at EU 27 level, most holdings are classified with an area of less than 5 ha, respectively 65.7% in 2013, a decreasing percentage over the years, thus increasing the share of farms in the other categories with a larger surface, by approximately 1% in each category, and in terms of value, 56.3% of holdings are classified under 400 euros. The highest shares are observed in the lower value class for

3 countries, Bulgaria, Hungary and Romania, around 80%.

To assess the effectiveness of agricultural holdings by economic size classes, in some countries of the European Union, two indicators were used: the ratio between outputs and inputs (O/I) and the elasticity coefficients of capital factors, labor and technical progress, by using the Cobb-Douglas function.

At the end of the chapter, the analysis is focused on the future of the agricultural holdings size through the complex approach to the holding, that is, through the three functions, economic, social and environmental, and on strategies for a multifunctional approach to the development of the agricultural holding.

Chapter II, entitled "***Methods and techniques for analyzsis and optimization of agricultural holding dimension***" lists and describes the methods and indicators used in optimizing the size of the agricultural holding.

The indicators that group certain characteristics of the holding are described, such as: characteristics regarding the physical size (land area, number of workers, number of animals); value characteristics (production value expressed in lei or euros, financial results); conventional characteristics (Standard production (PS, in Euro), economic size units (ESU), large vita units (UVM)).

Statistical indicators such as the average, the percentage increase in production compared to a reference year, the annual growth rate (r%), the trend equation expressed by the linear equation and the quadratic equation, the Cobb-Douglas production function of form $Y=A.X1^{\alpha}.X2^{\beta}.e^{\lambda t}$, the standard production (SP) of an agricultural product (crop or animal).

A questionnaire was drawn up and sent to a number of 79 holdings in Dâmboviţa County, filled in by the farmers, at the holdings location, in the presence of the author. The interpretation of the data was done by grouping the answers according to their share and descriptive univariate analysis of the data, absolute frequencies and relative frequencies, with the help of the $\chi 2$ (chi square) test.

The chapter also contains a brief description of the methods of designing and optimizing the economic dimension of the agricultural holding, grouped into classic methods and modern methods (polynomial and Cobb Douglas type production functions and the linear programming method).

The trend of modernizing the agricultural production within agricultural holdings is becoming more and more complex day by day and solving decisions can no longer always be solved by traditional methods, thus requiring the use of modern methods such as the linear programming method.

The source of the data in this paper is multiple: INS Tempo Online, FAOSTAT, EUROSTAT and the data from the questionnaires, collected from Dâmboviţa County. An important source was the Agricultural Accounting Information Network-RICA, FADNP.

Chapter III entitled "***Brief presentation of the natural, economic and social conditions of the studied area*** " is structured in four parts: the study of natural conditions regarding the agriculture's development in the South Muntenia region, the

analysis of the economic and social indicators that characterize the South Muntenia development region and Dâmbovița County, the analysis of the main indicators that characterize agricultural holdings from the region and the analysis and case study through the questionnaire applied to farm heads, in which a number of 79 holdings are analyzed from a physical, economic, social and environmental point of view from Dâmbovița county.

In the first part of the chapter, the natural resources of the South-Muntenia Development Region are analyzed, with a continental climate (80%), with very hot summers, moderate precipitation and frosty winters, with a varied relief, from the Bucegi and Leaota Mountains, to the Subcarpathian hills of Muntenia, the Cândești platform, at the high plain of Târgoviște and the Titu plain.

In part II, of the analysis of economic and social indicators that characterize the South Muntenia Region and Dâmbovița County, the evolution of the activity rate of the active population is analyzed to show that it reaches a minimum in 2021 of 49.3% at the level of the region and 46.7% in the rural area. In the county's agriculture, the population decreased from 65.9 thousand people in 2014 to 23 thousand people in 2021.

In the third part of the chapter, the development of agricultural holdings in the South Muntenia Region and Dâmbovița County during the period 2010-2020 is analyzed. At the regional level, by classes of economic size, it is worth noting the decrease of the total income per hectare, from 1931 euros, in class (1), (2000-8000 euros), to 655 euros in the 5th class (100000- 500000 euros), the increase in labor productivity from 1627 euros/UAM, at the 1st class, to 25770 euros/UAM, at the 6th class. It is also worth noting the poor efficiency of capital and labor, determined with the help of elasticity coefficients determined with the help of the Cobb Douglas function, a sub-unit level of capital elasticity coefficients is found from 0.015 to the 5th class of size to to a maximum of 0.821 in the 2nd class of the economic dimension, which in our opinion is that agricultural machinery and machines have a high degree of usage, or are morally outdated. The labor force elasticity coefficient has values from -0.712 at class 1, which meant a surplus of labor at the farm level, to 0.608 at class 6, which meant a complete underutilization of labor of work, caused in particular by the level of professional training. A characteristic at the county level is that of maintaining very small holdings, of increasing the areas fertilized with chemical fertilizers used, from 149 thousand ha in 1990 to 195 thousand ha in 2021, from the decrease in the number of animals per 100 agricultural ha, to cattle from 51.6 to 14.8 in 2021, in pigs from 84.7 to 32.7 and in sheep from 79.9 to 13.8.

In the fourth part of the chapter, a radiography of a number of 79 agricultural holdings is made, regarding their current situation and the ways they envisage for increasing the economic size of agricultural holdings.

The agricultural farms under analysis are part of all 6 classes of economic size, the land areas being between 2.73 ha/farm (5699 euros/farm) in the 1st class, 554.6 ha

(640553 euros/farm) in 6th grade. Regarding the incomes per hectare, they ranged from 2089 euros for the 1st class, to 3921 euros for the 3rd class and to 1155 euros for the 6th class. Of the 79 farm managers, 59 were male (75%) and 20 female (25%). The training level of farm managers was 45% with high school education and 55% with higher education.

Regarding the preparation along the way through the documentation that farmers do for the scientific management of production, research shows that there are no differences according to the class of economic or physical size of the farm, all of them being interested in documenting themselves through books and magazines, the Internet, friends and through the territorial agricultural consultant.

The analysis of the answers in the questionnaire was realised with the help of the Hi^2 method, in which it was sought to see the correlations between the economic size (in euros), distributed among the 6 classes and the answers given and the correlations between the physical size (in hectares) in 5 classes of size and the answers given.

Correlations are highlighted for the two size criteria and the annual planning of the production structure, the use of varieties and hybrids and the practice of precision agriculture, the difficulty of harvesting the production, the existence of storage spaces, which are significantly differentiated according to the class of economic size.

It should also be emphasized that the answers do not differentiate according to the class of economic size, such as obtaining credits for the production activity.

Regarding the ways of developing the economic size of the farm, grouped by economic size classes, we find that they differ according to the size class, such as: the ability to manage a larger farm, the profitability of the farm without subsidies, the bureaucracy and the environment of business, production diversification.

On the other hand, the answers regarding the increase in the economic size by: buying land, diversifying crops, raising animals and processing production, are not differentiated by size class, being accepted by the majority of respondents.

As an appreciation of the results obtained by the respondents, the question was also asked, if there is a chance to be left a legacy, with the answer options Yes, No or Possible distinctly differentiating significantly, depending on the size classes. Overall being 40% yes, 23% no and 37% possible.

Chapter IV entitled ***"Contributions to the establishment of the economic dimension of agricultural holdings in Dâmbovița County***" is structured in three distinct parts: the presentation of performance indicators, contributions to the establishment of the optimal size with the help of production functions and contributions to the optimization of the economic size, with the help of the model of linear programming.

In the first part are presented the main factors that determine the size of the farm, especially based on studies in this field, highlighting the factors that contribute to the increase in its economic size, such as the increase in physical size, the association of

agricultural holdings, the diversification of production, storage, processing and marketing.

In the second part of the chapter, with the help of the production functions, the economic dimensions of the agricultural holding are established according to the performance indicators regarding the net added value on the farm, the Output/Input ratio and the value production per hectare. These calculations were carried out at the level of the country, the region and at the level of Dâmbovița County, on the basis of the data taken for the period 2007 - 2020, from the RICA accounting network and reproduced by FADN, and the questionnaire.

We note the results regarding the highest VAN/work is obtained in Italy, of 254027 euros, for farms of 576.1 ha per farm, the Netherlands with 98429 euros/farm for farms with an area of 119.4 ha, agricultural land.

In order to maximize the Output/Input (O/I) ratio at the farm level, the EU was targeted, 8 countries of which 4 with high performance indicators (Germany, Denmark, Italy, the Netherlands) and 4 countries with less performing indicators (Bulgaria, Romania, Hungary, Poland) from which we highlight Italy with the ratio of 1.564, for farms of 51.7 ha, Poland with 1.419, for farms of 227.4 ha, Romania with 1.243 for farms of 834.4 ha, and the EU average of 1.086, for farms of 236.1 ha. It should be noted the high areas at which this O/I indicator is maximized, being 950 ha for Hungary, 745.4 ha for Bulgaria, 227.4 for Romania.

At the level of Romania and the South-Muntenia Development Region, this ratio was maximized by physical size classes, the highest being for the farm surface of 265 ha (O/I=1.84), at the country level and 1476 ha (O/I=5.28) at the regional level.

The economic size of the farm was also optimized based on the responses from the questionnaire prepared at the Dâmboviţa county level, from which it was found that the farm with the maximum production per hectare is in the 2nd class of economic size with 22717 euros/farm and 2704 euros/ha , with a crop structure of: 37.7% cereals, 25.7% technical plants, 2.7% fodder, 29.2% orchards and 4.7% vegetables, for a farm area of 8.4 ha of agricultural land.

In the third part of the chapter, with the help of the linear programming model, two factors that influence the economic size of the farm were simulated, namely the surface of the farm and the diversification of crops. Thus, it started from a case study of the SC Agro Alexoana SRL farm in Braniştea commune, Dâmbovița county. The holding has an area of 776 ha of arable land and the technical and economic means to cultivate wheat, barley, grain corn, sunflower and rapeseed, for which a model was drawn up considered the initial model. The data in the model was an average of farm results over the last 6 years, data for which the coefficients of variation and the mean amplitudes of the range between the lower and upper bounds, around the mean, for a 95% probability were calculated, and which they turned out to be very large.

Compared to this initial model drawn up to maximize the production value, two more models were drawn up by parametrizing the surface at 726 ha (-50ha) and at 826 ha (+50). The three models were in turn parametrized by crop diversification by adding three more crops (peas, autumn potatoes and alfalfa hay), and thus 6 models were drawn up. In order to analyze the economic implication as well, these models were solved both for the objective function of maximizing the production value and for maximizing the profit corresponding to the production value.

The models were solved using the Solver program in Excel, and the primal and dual solutions were interpreted for each model. For the two researched factors, syntheses were drawn up regarding the influence of the physical size and the influence of crop diversification on the economic size of the agricultural holding.

From the analysis of the influence of the physical size (increase or decrease of the surface), the other factors remaining constant, it is found that it remains constant as in the case of the initial model, namely 4883 lei/ha. The same thing happens with the profit per hectare which remains at 3400 lei/ha. So only the physical enlargement of the holding does not bring an increase in value production or profit per hectare.

From the analysis of the influence of the crops diversification, other factors remaining constant, namely their increase from 5 crops to 8 crops, it is found that the value production shows a downward trend, from 5108 lei/ha at the variant of 726 ha, to 5023 lei/ha for the 776 ha variant and at 4883 lei/ha in the 826 ha variant. The profit per hectare has the same downward trend, from 3515 lei/ha in the first variant, to 3461 lei/ha and to 3352 lei/ha in the third variant. It follows that the crops diversification influences the economic dimension of the agricultural holding, at the same level as the other production factors. Another positive influence that the crops diversification has is that of the crops structure changing, with a beneficial influence on sustainable crop rotation at the farm level. Thus, in the version of 776 ha, the current version of the farm, it practices a structure of 65% cereals and 35% oleaginous plants, and in the optimized version with several crops, cereals have 58%, oleaginous plants 20%, leguminous plants 20% and technical plants 2%, which will allow leguminous crops to return once every 5 years on the same surface.

In Chapter V, entitled *"Conclusions and proposals"* the main aspects that emerged from the work are summarized.

The conclusions resulted from the bibliographic analysis, the calculations performed, the case study carried out on the basis of a questionnaire applied to farmers in Dâmboviţa County and the solutions of the mathematical models.

The proposals aim at the need, at the level of farms, to put sustainable agricultural measures into practice, namely the need to move to a sustainable agriculture that integrates into the overall sustainable development of our country.