MODELS OF PLANNING AND OPTIMIZATION CONSTRUCTED TO SIMULATE THE BEHAVIOR OF FARMS IN ROMANIA

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Abstract

The risk is a very important variable in the simulation behavior farms. This paper aims to build programming models to simulate the behavior of agricultural farms, that must be calibrate by the culture plan of the year basis or as the average over several years by the agricultural holding. Economic rationale behind this requirement is that in this way the model adequately represents the environment in which the decision maker agricultural structure shall base its decision. The purpose is to promote the setting up of farms whose size allow the practice of a viable, sustainable agriculture, capable to apply the newest technologies and lead to profit and efficiency, to the economical and organizational consolidation. As a consequence, the resizing of the agricultural holdings, the partnership between the producers, the integration of the agricultural production, the rural development, the consumers' constant request for agricultural and food products, the decrease of the deficit of the commercial balance for the agricultural products, the increase of the population's life standard, the safety of the food, all these are goals that have to be under the continuous attention of the authorities at central and local level. Production planning is a fundamental concept that is based on the concept of production organization products, actual production, marketing and service activities and post -sales, taking into account the requirements of actual and potential consumer or user in the direction of their satisfaction with maximum efficiency. The presence of a complex production system calls for linear programming restricts need to formulate a very complex system in order to calibrate the model to observed crop plan. In several cultures the proportion of traditional optimization system was restricted by constraints "rotational" or "flexibility". This category of constraints determines the optimal solution not only for basic but they are suitable for the simulation of policies that attempt to predict the effects of changing prices, costs or access to resources on the behaviour of farmers. Model solutions, simulation under different agricultural policy are also limited by the constraints identified and formulated in the basic.

Key words: models, simulation, agricultural, holdings, efficiency,

Traditional means of linear programming farm simulation behaviour. From the historical point of view of decision-making structures optimization using linear programming was developed for the U.S. army during the Second World War by George Dantzing. Linear programming models were used since then in the process of decision making. The decision maker must identify and quantify the decision limits (in terms of available resources, time constraints available in the available labour force in terms of funding, etc.) and to specify an objective function to be maximized (profit) or minimized (cost).

Linear programming models applied in agriculture helps to answer a set of questions essential to agricultural decision-maker, as follows:

- *How to produce?*
- *What to produce?*
- *What to produce?*
- *What to produce?*
- *How to produce?*

Building a linear programming model involves the development of closer links between the objectives and how constraints dominate agricultural activity maker. The constraint built is a simplified picture of the environment in which farmers base their decisions. By changing the structure of the constraints due to anticipated changes in agricultural politics, for example, or in rural finance policy can be expected to be reactions agricultural maker:

- *What will occur under the new conditions?*
- *How will adapt its production process?*
- *How will it change the structure of production?*

In carrying out agricultural decision-maker will take into account the constraints that define the activity and will consider the objective of maximizing revenue.

This last assumption is satisfied in most linear programming models built by maximizing

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the objective function of farm gross margin. The problem of constructing a linear programming program is therefore to identify those branches of production that must be placed in the structure of production and the quantities that must be produced in order to maximize income of farmers knowing that inputs being used are limiting and expensive.

Linear program can be written as:

$$\max Z = \sum_{j=1}^{n} c_j * x_j \quad (1.1),$$

in compliance with the following system of constraints:

$$\sum_{j=1} a_{ij} x_j \leq b_i \ regardless of \ "i"$$

$$x_j \geq 0 \ regardless \ of \ "j"$$

Where:

- x_j represents the activity (production) in the branch j determined in a manner endogenous;
- c_j represents gross margin (defined as the difference between income per unit area cultivated branch "j" and recorded the variable costs per unit area) produced per unit of activity x_j;
- a_{ij} represents coefficients techniques and that the amount of factor required to produce a unit of output j;
- b_i represents available farm inputs;

Positive mathematical programming method uses three steps Howitt (1995b):

Stage I: Determining the dual of activities "unconstrained" model. Phase involves the construction of a linear programming model that will be generated based on these dual values;

Stage II: Determination of parameters marginal production function. Based on observed data in the farm or production system under analysis and dual values determined in phase I are established parameters (slope and constant term) marginal production function of the objective function.

Stage III: Building a model of behavioural simulation. Based on the marginal production function parameters determined and observed data at the system level analysed (technical and economic factors; allocations surfaces) builds positive mathematical programming model (1.1). The optimization model is to obtain the allocation of the land area of the base year, thus respecting the whole complex causal decision maker acting on agriculture, including how he reacts to environmental changes.

Whether following simplified situation identified at a farm in one year basic thought:

Table 1

Simplied situation identified as the farm in one basic year

em name	Unit	Wheat	Oat
Production price	Euros/t	2,98	2,20
Average cost	Euros/ha	129,62	109,98
Average production	Tons/ha	69	65,9
Gross margin calculated	Euros/ha	76	35
The land occupied in the base year	Ha	3	2

At the farm level you want to build a model simulation of the behaviour of farm, that such behaviour to provide agricultural decision-maker under the agricultural credit politics change.

Figure 1 gives the number of graphic crops farm plan given that it has a limited area of land (land base year is limited to the availability of existing 5-hectare farm) and respecting upper calibration limits (value of production of the two crops).

It should be noted that under optimal allocation field calibration constraints are limiting wheat by the fact that this culture write the highest average gross margin per unit of acreage. The calibration of the acreage of wheat the observed value in the base year to take account of risk aversion of the farmer (activities with a high gross margin are characterized by a higher risk). The area of land available will restrict the acreage of oat instead.

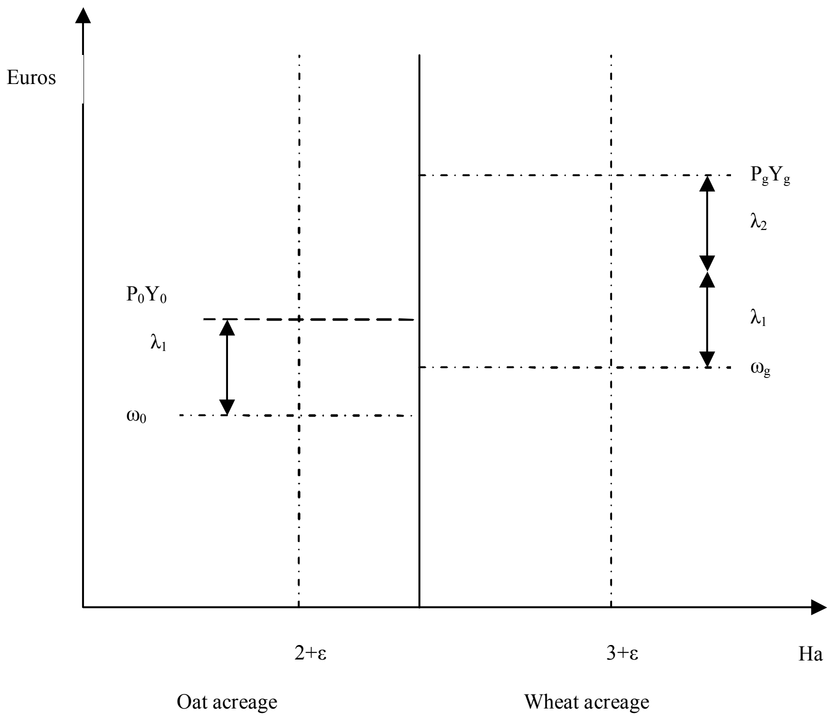

Figure 1 **Plan of farm crops**

In order to determine the parameters objective function of the model, defined by the equation 1.1, is solved a system of two equations based on the unknown β_l şi δ_l of the production function. Whether production function with a quadratic form, the first equation of the system is given by the average of the crop "i":

$$\overline{y_i} = \beta_i - \delta_l x_i \quad (2.10)$$

In order to define the equation number two dual system will use the value of the calibration constraints (λ2). This shadow price is defined to be the difference between the average productions (VAP) calibrated crop (wheat), and the marginal production of the same crop (VMP).

The constraints of calibration have just served to highlight the set of variables, which have influence the farmer in the base year. After optimization of the model was obtained as the optimal solution following crop plan:

Table 2

Optimal solution of crop plan

Wheat	Barley	Corn	Rape	Sunflower	Soy	Other
367,01	116,01	20,01	37,01	164,01	257,01	8,94

After applying this plan were obtained profit crop 174.738,3 Rol.

After building this model is apparent that the use of other branches of production than those explicitly mentioned in the farm by his declaration RICA is limited by land area owned at 8,94 Ha. According to the model results that last piece of land has been allotted by the decision maker unnamed farm these crops. Results that the real opportunity cost of the land must be equal to the gross margin of the last units of land allocated. In our case the marginal opportunity cost of land is equal to 3 Rol. Based on these considerations and using positive mathematical programming theory it follows that the dual values of calibration constraints are equal to:

$$\lambda_2 = \begin{pmatrix} \lambda_{2g} = 90,5; \lambda_{2o} = 215,9; \lambda_{2p} = 2196; \lambda_{2r} \\ = 599; \lambda_{2f} = 146,75; \lambda_{2s} = 91; \lambda_{2a} = 0 \end{pmatrix}$$

On the basis of these data and using last equation for low-income to determine the parameters for all the six crops were calibrated with the above model:

- determining the parameters of income function for wheat crop:

$$\delta_g = \frac{90,5}{450*367} = 0,000054$$ Value used to calculate the constant term given by fallow equation:

$$\beta_g = 4,47 + 0,000054*367 = 4,66$$

- determining the parameters of income function for barley crop:

$$\delta_o = \frac{215,9}{330*116} = 0,000564$$ Value used to calculate the constant term given by fallow equation:

$$\beta_o = 3,13 + 0,000564*116 = 3,19$$

- determining the parameters of income function for corn crop :

$$\delta_p = \frac{2196}{2000*20} = 0,0549$$ Value used to calculate the constant term given by equation:

$$\beta_p = 2,55 + 0,0549*20 = 3,648$$

- determining the parameters of income function for rape crop :

$$\delta_r = \frac{599}{600*37} = 0,026$$ Value used to calculate the constant term given by equation:

$$\beta_r = 2 + 0,026*37 = 2,962$$

- determining the parameters of income function for sunflower crop:

$$\delta_{fs} = \frac{146,75}{700*164} = 0,0013$$ value used to calculate the constant term given by fallow equation:

$$\beta_{fs} = 2,43 + 0,0013*164 = 2,64$$

- determining the parameters of income function for soy crop :

$$\delta_s = \frac{91}{700*136,34} = 0,00095$$ Value used to calculate the constant term given by fallow equation:

$$\beta_s = 1,29 + 0,00095*136,34 = 1,41$$

Following equation as the objective function is:

$$\max\{[450(4,66 - 0,00054\,x_g) - 1918]x_g + [330(3,19 - 0,00564\,x_o) - 814]x_o + [2000(3,648 - 0,0549\,x_p) - 2901] + [600(2,962 - 0,026\,x_r) - 598] + [725(2,64 - 0,013\,x_{fr}) - 1612] + [700(1,41 - 0,00095\,x_s) - 809] + [500*0,11 - 52]x_a\}$$

Subject of the next set of constraints:

$$(i)\; x_g + x_o + x_p + x_r + x_f + x_s + x_a \le 970$$

The extension of the model and its practical application

Analysis the impact of Common Agricultural Politics concerning Romanian agricultural sector, specialized in crop production, advertise building a representative model at the sectorial level. In this regard, bibliographic concerns in this domain, identified several opportunities for expansion of simple farm-level models at the sectorial level, presented in the following ways.

CONCLUSIONS

Following results can draw the following conclusions:

- After accession to the European Union result in lower revenues Romanian farmers. Dropping these revenues depends on the situation farms. Thus in the event that farm practice technology resource consumption is important shock of joining the European Union will be important (30% decrease in net income/hectare/obtained);
- Farm shows the phenomenon of specialization towards more efficient productions. For productions in the new market conditions become bad expects achieving technology changes;
- The influence of the financial parameters revealed that access to credit has a more important influence on farm income and crop rotation on the structure than the interest rate.

Method of representative farms classification of farms in the universe involves a small number of homogeneous groups and building a model for a representative firm in each group. These model farms are then aggregated using sector model number of each type of firm as weights.

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