Designing a mathematical model to optimize the size activities in the production plan for SC RENTEA SRL

Mihaela Cristina Vlad and Mihaela Nitu

Research Institute for Agricultural Economics and Rural Development, National Institute of Research Development for Machines and Installations Designed to Agriculture and Food Industry

20 November 2015

DESIGNING A MATHEMATICAL MODEL TO OPTIMIZE THE SIZE ACTIVITIES IN THE PRODUCTION PLAN FOR SC RENTEA SRL

VLAD CRISTINA MIHAELA[1], NITU MIHAELA[2]

Summary: *Planning is the process of identifying the present situation, setting goals and define ways to achieve the objectives. Planning is the primary function of business management because of time preparing space for all other aspects of management, is considered a link between past and present [2]. Use of computer technology in agriculture will have a significant effect, provided achieving integrated information systems at macro (national agriculture, ministry) and micro (farm, farms etc.). Expanding use of computers in agriculture will ensure rational use of resources, their savings, the provision of complete and operative information on the conditions of production, the supply-sales market, the cost on profitability, etc. Thus, this work demonstrates the need and applicability of computer systems at the level of companies.*

Keywords: *informatics, planning, goals*

INTRODUCTION

To enhance management practices to ensure high quality products and competitive skills, farms will need to adopt methods of decision support and proper management. Accordingly, holdings want to become and/or remain competitive they need adequate quality resources: financial, material, energy, human and not least information. In order to increase competitiveness of agricultural products on domestic and foreign markets it is imperative to improve existing information flows at the branch level and to provide methods for grounding the business and the use of information technology to innovate the field, taking into account the strategies defined at European level[1].

MATERIAL AND METHODS

AGR4 program allows developing production and business plan at farm level (vegetable farms) by calculating the alternatives on:

- plan culture, technical and economic indicators at the level of the holding as a whole cultures and component technologies for each crop, the necessary material resources, manpower and financial resources annually, months and decades each culture and the whole farm;
- demand for tractors and agricultural machinery months and decades;
- calculating the normal plowing hectares (hantri) to mechanized farming operations executed

AGR4 program can update all the indicators monthly or at any time, information which is realistic, "Today" in the act of operative management, increasing the effectiveness of the decisions. Production plans and budgets, revenues and expenditures have several sections and include objectives that must be completed in a year. These are the main tools in the work of management in agricultural companies and farms components.

The main indicators calculated using the program AGR4 are: list of crops in the plan and the main indicators of materials necessary technical-economic indicators at farm, vegetable farms, calculate the necessary amount per calendar month assignment requisition means calendar month calculating the necessary mechanical means, the necessary operating hours on Monday and decades of agricultural machinery.

In compiling mathematical model was used matrix coefficients characterizing techniques technological alternatives, the crops developed using AGR4 program product, and the product-PROCSMS_SIMPLEX.prg Program, which gives us the opportunity to add interactive

[1] Dr.ec. Cristina Mihaela Vlad Research Institute for Agricultural Economics and Rural Development, cristina.vlad@iceadr.ro

[2] Drd.ing. Nitu Mihaela, National Institute of Research Development for Machines and Installations Designed to Agriculture and Food Industry, rosumihaelan@yahoo.com

mathematical model of linear programming. Simplex method for solving the model was used Prog_lin.exe program in Matlab library (subroutine fd_prog_xls_9).

RESULTS AND DISCUSSIONS

Starting from technologies used in SC RENTEA SRL in Dolj County were developed technological options for crops they practice: winter wheat, winter barley, barley, maize, sunflower, alfalfa. Technological descriptions were drawn on the experience of farmers and literature data. These technologies have been included in a linear programming model that offered us by solving solutions for crop structure.

Calculation of technical and economic elements specific to each culture was performed with the Software AGR4, which allows a quick understanding of the economic indicators representative for each technology. The program allows calculating technical key indicators - economic characterizing production technology based on the data sheet mechanical technology on the work, the workmanship, materials and material consumption. These expenses are spread over months, depending on when they were scheduled to be executed.

With AGR4 program was compiled and calculated by calendar month, consumption of mechanical force (mechanical ZN), manual labor (manual ZN) expenditure.

In compiling mathematical model on optimizing gross margin in SC RENTEA SRL, Dolj county, to use technical coefficients matrix characterizing technological alternatives, the crops developed using AGR4 program product, and the product-PROCSMS_SIMPLEX.prg Program, which gives us the possibility of completing interactive mathematical model of linear programming.

We PROCSMS_SIMPLEX product-schedule finalized linear programming model as follows:

- Including economic function (object) (FE)

[Max] Gross margin (lei) = 528x1 + 610x2 + 464x3 + 688x4 + 380x5 + 690x6;

In this way it obtained mathematical model for SC Rent Srl, which is stored in a text file in order to deal with the method simplex. The three model variants corresponding to each of the economic functions (Table 1).

Simplex method for solving the model was used Prog_lin.exe program in Matlab library (subroutine fd_prog_xls_9). This program allows you to retrieve data from a text file generated by AGR4 envelope, address it and display the results in a xls file type.

The model that includes enrollment in xls spreadsheet type (Table 1) ("Sheet1"), resolution, and playback model results, respectively dual solution and the solution first.

The first model interpreting solution for SC RENTEA SRL, Dolj County, get the size and structure of acreage and gross margin value.

Following the data in Table 2 following notice:

- In Sc Rentea Srl, wheat occupies the largest share 28.9% (22 ha) followed by corn and sunflower 25% (19 ha), barley 13.2% (10 ha) and alfalfa 7.9% (6ha);
- The variants crop structure optimization is changed as follows:
- Option 1 proposes a structure with 59 hectares planted, 20 ha maize (33.9%), by 15 ha for alfalfa and sunflower (25.4%) and 9 ha barley (15.2%);
- Version 2 uses 70.7 ha spread over 22.4 hectares barley (31.7%), 19.8 ha maize (28%), 15 ha sunflower (21.2%) and 13.5 ha alfalfa (19.1%);

The third variant uses all the available area, 76 ha with three crops - barley 36 ha (47.4%), 25 ha maize (32.9%) and 15 hectares of sunflower (19.7%).

Table 1 model, transcribed for solving the Prog_lin.exe

6	19	1	0	0	0	0	0	
528	610	464	688	380	690			
3002	3115	2805	3510	2950	2310			
1,125	0,267	0,267	1	1.1	1	132	ZNMAN 3	<
1263	0,234	0,234	0,137	1.17	0,137	132	ZNMAN 7	<
0.059	0.06	0.06	2.81	0,069	2.81	200	ZNMEC 3	<
0.35	0.4	0.4	042	0,118	0.42	100	ZNMEC 4	<
0.22	0.04	0.04	0.196	0.212	0.196	100	ZNMEC 5	<
3.22	3.22	3.22	2.03	0	2.03	200	ZNMEC 9	<
2.23	2.23	2.23	1.44	0	1.44	200	ZNMEC10	<
1.20	120	64	250	150	250	15000	CONSAZOT	<
50	50	50	50	150	50	16500	CONSFOSFOR	<
50	50	64	120	150	140	15000	CONSPOTA	<
38	38	38	73	223	46	6000	RTOTMAN	<
36	40	40	41	68	32	15000	RTOTMEC	<
0	0	0	200	0	0	15000	LUCTERTI	<
1	1	1	1	1	1	76	Total area	<
0	0	0	1	0	1	40	Horing area	<
1	1	1	0	0	0	50	Straw area	<
0	0	0	0	0	1	15	Sunflower	<
0	0	0	0	1	0	15	Alfalfa	<
0	0	0	0	1	0	15	Alfalfa	>
Corn	Barley	Barley	Maize	Alfalfa	Sunflower			

Processed: Evidence of technical and operative SC RENTEA SRL, Dolj County

Table 2 The size and structure of cultivated areas in SC RENTEA SRL in optimized variants (V1, V2) V3)

No. No.		**SC RENTEA SRL**		**V1**		**V2**		**V3**	
		ha	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**
1	Corn	22	28.9	0.0	0.0	0.0	0.0	0.0	0.0
2	Barley	10	13.2	9.0	15.2	22.4	31.7	36.0	47.4
3	Barley		0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Corn consumption	19	25.0	200	33.9	19.8	28.0	25.0	32.9
5	Alfalfa	6	7.9	15.0	25.4	13.5	19.1	0.0	0.0
6	Sunflower	19	25.0	15.0	25.4	15.0	21.2	15.0	19.7
7	Total	76	100.0	59.0	100.0	70.7	100.0	76.0	100.0

Processed: Evidence of technical and operative SC RENTEA SRL, Dolj Couty

In terms of size and structure Gross margin Sc Rentea Srl it has a value of 607.6 lei / ha, with a total of 46,178 lei (table 3).

- Option 1, the proposed structure brings a total of 35,303 lei, with a gross margin of 598.3 lei/ha;
- Option 2 is at a level of gross margin 604.8 lei / ha worth a total of 42,751 lei;
- An important contribution shown in the third embodiment, a plurality of 49 510 lei and a gross margin of 651.4 lei per ha / ha.

From the analysis it is observed that Alternative 3 is the most advantageous.

Table 3 Gross margin size and structure of SC Rentea Srl, and optimized variants (V1, V2) V3)

No. No.	Specification	MB (euro / ha)	SC RENT SRL		V1		V2		V3	
			ha	lei	ha	lei	ha	lei	ha	lei
1	Corn	528	22	11616	0.0	0	0.0	0	0.0	0
2	Barley	610	10	6100	9.0	5474	22.4	13655	36.0	21960
3	Barley	464		0	0.0	0	0.0	0	0.0	0
4	Corn consumption	688	19	13072	200	13779	19.8	13607	25.0	17200
5	Alfalfa .	380	6	2280	15.0	5700	13.5	5139	0.0	0
6	Sunflower	690	19	13110	15.0	10350	15.0	10350	15.0	10350
7	Total	X	76	46,178	59.0	35,303	70.7	42,751	76.0	49,510
8	Gross margin (lei / ha)			607.6		598.3		604.8		651.4

Processed: Evidence of technical and operative SC RENTEA SRL, Dolj County

In Table 4, we can see the main resource consumption in society and in optimized variants:

- Consumption of days time in March - from an available 132 days, the company consumes 76 variant 1-54, version 2 - 47.82 days and 49.61 days 3- version;
- Normal day in July - where have all the 132 days, the company consumes 48 days, variant 1-24, version 2 - 3 version 14.16 and 13.9 days;
- Regarding the consumption of days mechanized - for all five months, eating the largest we see society, version 1 has the lowest consumption (area less), and variant 3 (same surface), we see greater consumption lower than the actual situation.
- The same results are recorded and cosnumul fertilizer, water, manual and mechanized wages.

It concluding that it optimized version 3 adds lei gross margin/ha on the same surface as the company with a much lower consumption of resources.

Table 4 Consumption of the main resources in SC Rentea Srl and optimized variants (V1, V2, V3)

No. No.	Specification	UM	Resources	Resources consumed Rentea	V1 consumed resources	Resources consumed V2	V3 consumed resources
1	ZNMAN 3	hours	132	76	54	47.82	49.61
2	ZNMAN 7	hours	132	48	24	14.16	13.9
3	ZNMEC 3	hours	100	102	100	108	114.56
4	ZNMEC 4	hours	100	36	20	31	31.2
5	ZNMEC 5	hours	100	14	10	9	9.28
6	ZNMEC 9	hours	100	245	100	200	197.12
7	ZNMEC10	hours	100	171	70	140	137.88
8	CONSAZOT	Kg as	14000	15570	12084	14000.00	14320
9	CONSFOSFOR	Kg as	16500	5350	4450	3801.67	3800
10	CONSPOTA	Kg as	15000	8260	7202	6729.09	6900
11	RTOTMAN	lei	6000	5513	5838	3799.80	3883
12	RTOTMEC	lei	15000	3767	2680	2943.00	2945

Source: Own calculations

For a complete interpretation of the solutions resulting from solving mathematical model uses dual solution that gives us the marginal contributions of resources restrictive (limiting) in four solution results (Table 5).

The dual variable we can see totally consumed resources (become limiting factors) and marginal contribution of each objective function value, as follows:

- In alternative 1 were totally consumed ZNMEC 3 with a marginal contribution from 10946 lei, ZNMEC9 a marginal contribution of 18740 lei and sunflower surface with a marginal contribution of 30 lei. It reaches an objective function value of 35302 lei.
- In the latter were consumed ZNMEC 3 with a contribution margin of 7674 lei, ZNMEC10 with a contribution margin of 24285 lei, RTOTMAN with a contribution margin of 10082 and the area of sunflower with a contribution margin of 711 lei. It reaches a value of 42,751 lei objective function.
- Version 3 has three limiting factors (resources consumed entirely), namely: the total area of 76 ha, with a marginal contribution from 46360 lei. Hoe surface 40 ha, with a marginal contribution from 3120 lei and sunflower area 15 ha, with a contribution margin of 30 lei. Objective function value totaling 49,510 lei.

Table 5 Dual solutions of the three variants

No.	Specification	Option 1			Option 2			Option 3		
		Resource Consumption	**Marginal Cost**	**Marginal contribution**	**Resource Consumption**	**Marginal Cost**	**Marginal contribution**	**Resource Consumption**	**Marginal Cost**	**Marginal contribution**
1	ZNMAN 3	53.92	0	0	55.6	00	0	49.61	0	0
2	ZNMAN 7	24.45	0	0	25.8	00	0	13.9	0	0
3	**EC ZNM 3**	**100**	**109.46**	**10946**	**100.0**	**76.7**	**7674**	114.56	0	0
4	ZNMEC 4	20.07	0	0	25.2	00	0	31.2	0	0
5	ZNMEC 5	10.4	0	0	106	00	0	9.28	0	0
6	**EC ZNM 9**	**100**	**187.4**	**18740**	1,427	00	0	197.12	0	0
7	**ECLO ZNM**	70.45	0	0	**1,000**	**242.8**	**24285**	137.88	0	0
8	CONSAZOT	1208.363	0	0	13409.0	00	0	14320	0	0
9	CONSFOSFOR	4450.04	0	0	4886.6	00	0	3800	0	0
10	CONSPOTA	7201.95	0	0	7621.0	00	0	6900	0	0
11	**RTOTMAN**	5837.98	0	0	**6000.0**	**1.7**	**10082**	3883	0	0
12	RTOTMEC	2680.06	0	0	3105.9	00	0	2945	0	0
13	LUCTERTI	4005.45	0	0	3955.4	00	0	5000	0	0
14	Total area	59	0	0	70.7	00	0	**76**	**610**	**####**
15	Area hoeing	35.03	0	0	34.8	00	0	**40**	**78**	**3120**
16	Area straw	8.97	0	0	22.4	00	0	36	0	0
17	**Tis area**	**15**	**2**	**30**	15.0	47.4	711	**15**	**2**	**30**
18	**Area alfalfa min**	**15**	**186,22**	**2793.3**	13.5	00	0	0	0	0
19	**Area alfalfa max**	**15**	**186,22**	**2793.3**	13.5	00	0	0	0	0
20	Total contribution margin			35302.6			42,751			49,510

CONCLUSIONS

1. The interpretation of entries received, the mathematical model, we get the size and structure acreage and gross margin value

- In Sc Rent Srl, wheat occupy the largest share of 28.9% (22ha) followed by corn and sunflower 25% (19ha), barley 13.2% (10ha) and alfalfa 7.9% (6ha), where gross margin has a value of 607.6 lei / ha, with a total of 46,178 lei;
- In alternate crop structure optimization is changed as follows:
- Option 1 proposes a structure with 59 hectares planted, 20ha maize (33.9%), each 15ha for alfalfa and sunflower (25.4%) and 9 ha barley (15.2%), where gross margin has a value of 35,303 lei with a gross margin of 598.3 lei / ha;
- Version 2 uses 70,7 ha spread over 22.4 hectares barley (31.7%), 19.8 ha maize (28%), 15 ha sunflower (21.2%) and 13.5 ha alfalfa (19.1%), where the gross margin is estimated at 604.8 lei / ha worth a total of 42,751 lei;
- The third variant uses all the available area, 76 ha with three cultures - 36 ha barley (47.4%), 25 ha maize (32.9%) and 15 hectares of sunflower (19.7%), where the gross margin is estimated at 49 510 lei and a gross margin of 651.4 lei per ha / ha.

2. The dual interpretation, namely the marginal costs of resources consumed entirely attached declaration that:

- version 1 were totally consumed ZNMEC 3 with a marginal contribution from 10946 lei, ZNMEC9 a marginal contribution of 18740 lei and sunflower surface with a marginal contribution of 30 lei. It reaches an objective function value of 35302 lei;
- in the latter were consumed ZNMEC 3 with a contribution margin of 7674 lei, ZNMEC10 with a contribution margin of 24285 lei, RTOTMAN with a contribution margin of 10082 and the area of sunflower with a contribution margin of 711 lei . It reaches a value of 42,751 lei objective function;
- version 3 has three limiting factors (resources consumed entirely), namely: the total area of 76 ha, with a marginal contribution from 46360 lei. Hoe surface 40 ha, with a marginal contribution from 3120 lei and sunflower area 15 ha, with a contribution margin of 30 lei. Objective function value totaling 49,510 lei.

3. Promoting the use of scientific methods of planning but especially for agricultural management software, namely to promote the use of information technology to support innovation in agriculture; using programs that can identify risk production has an important role in decision making, both in terms of choosing the optimal and hierarchical level that will be taken. The crowd variants of decision, the decision maker will choose which of them will generate a minimum of maximum foreseeable loss loss [3].

4. We believe that there is significant use of economic-mathematical methods in agriculture: integrated planning of activities and sustainable use of resources, optimizing the size and profile of farms, crop technology optimization, etc., which could help increase labor productivity and economic efficiency.

BIBLIOGRAPHY

1. Cofas E., 2009, Effective Information Systems in Analyzing the Profitability of Farms, PhD thesis, Veterinary Medicine, Bucharest
2. Pătruți F., Importance of Planning in Farm Work, https://www.scribd.com/doc/41677501/Importanța-planificării-in-activitatea-exploatațiilor-agricole
3. Helen Thomas, Simona Roxana PATARLAGEANU, Elena Cofas, Gheorghiță Mircea Mircea Nastase, 2009 Model for estimation and evaluation of production efficiency in agriculture activities trough *Information Systems*, Metalurgia International vol. XIV (2009), Special Issue No.13, pp 40-45, ISSN 1582-2214.