A model for the agricultural planning at farm level for the European Union countries

Author:

Vítor João Pereira Domingues Martinho (vdmartinho@esav.ipv.pt)

Agricultural School. Polytechnic Institute of Viseu, 3500 Viseu, Portugal

Abstract

The agricultural sector considering its specificities needs frequently good strategic plans, since the production until the commercialization. However, the planning in the agriculture is not easy, because depends on several factors, as the climate conditions, the biologic vulnerabilities (pests and diseases), the socioeconomic conjuncture, the changes in the legislation and the farming markets. The linear programming models, as optimization techniques, usually are adjusted methodologies to help in the construction of these agricultural plans. In these frameworks, this investigations pretends to be an stimulating contribution for the scientific community and for the several agricultural operators (farmers, policymakers, etc) building an accessible (namely for the farmers) and simple planning model, based in the linear programming methodologies, with the data available in the Farm Accountancy Data Network (FADN, 2014), across the period 2007-2011, for the former twenty seven European Union countries. These models are flexible and easily adaptable for new circumstances, helping, in this way, in the prevision of the respective implications. This pretends to be a first approach with these methodologies and these kind of data.

Keywords: Agricultural planning; European Union; Farm Accountancy Data Network; Linear programming models.

Jel codes: C61; M41; O52; Q12.

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1. Introduction

A good agricultural planning presupposes several steps until to be in conditions to be implemented in the farms, namely when the intention is to start from the beginning and do it all again.

At a first step it is important to collect information about the soil and climate conditions about the local where the farm is located. In nowadays, there is many information about the soil and climate, sometimes georeferenced, in public platforms that can help the agricultural operators in the systematization of this information.

A second step is about the collection of information related with the legislation applied, the farming markets associated and the several financial supports. After the systematization of this information it is important to identify agricultural productions adjusted to the conditions observed in the information collected and analyzed.

The next step, it is obtain information about the costs and revenues associated with the agricultural activities identified. With this information is possible to select the productions more adjusted to the intended that in general is to optimize results. This agricultural activities selection can be done by various management methodologies, as the budget methods (total or partial), the cash flows (total or partial) and the mixed and linear programming models, among others.

In this work, the objective is to center the research in the economic and management part, namely in the procedures related with the selection of farming activities and with the adjustment of the farms structures dimension and daily functioning to optimized frameworks. For that, it was built a simple model, based on the linear programming, for the European farms, with statistical information available in the FADN (2014) database, for the European Union countries, over the years, in average, from 2007 to 2011.

The linear programming models, in comparison to the others methods, have the advantages of obtain optimized solutions and allow to interrelate different activities which is what happen in the realty, namely between, for example, animal and vegetal productions, where some vegetal productions are profitable is interrelated with the animal activities.

This is an interesting contribution, considering our knowledge, to the scientific community and to the agricultural operators, since the policymakers until the farmers, which may be more one support to the design of new strategies for the improvement in the agricultural performance.

2. Literature related

The agricultural planning is crucial for the all economic performance (Paster, 2004). Recently the geographic information systems have been used as support methodology of agricultural planning, through the construction of land maps that allow elaborate plans base on the visualization of georeferenced information (Saroinsong et al., 2007; Bryan et al., 2011; Rosa and Privitera, 2013; Russo et al., 2014). The geospatial tools are interesting supports for the plans construct in the agriculture, taking advantage of significant improvements verified in the new technologies (Erickson et al., 2013; Bruin et al., 2014).

In certain cases, namely in zones of difficult access, it is, already, possible collect information for the farming planning, namely that related with the soil conditions, through algorithms based in data available in public database (Coopersmith et al., 2014).

Another question about the farming planning is related with the irregularity of the parcels in the farms, what bring some complications in the introduction of machines and in the displacements. In these cases the challenge is to reduce the distances and minimize the costs associated with the several practices (Zhou et al., 2014), as for example those related with the diverse operations that involve the harvesting and distribution of agricultural productions (Ahumada and Villalobos, 2011; Bakhtiari et al., 2013).

Independently of these several advances in the tools for the agricultural planning, there are different concerns about the farming growth and development process that must be taking into account in each plan, namely those related with the social and environmental aspects which may be so important as the preoccupations with the returns optimization. The sustainability cannot be forgotten in the agricultural plans (Pearson, 2013).

The uncertainty verified in the agricultural activities related with the production of fresh products calls for efficient plans to reduce the risks associated with the several activities involved since the production until the final consumer. The complications appear in the supply and are related with the characteristics of the productions in the agriculture (perishable products and atomized farms, in general small and in great number, what bring various complications) and appear in the demand and are associated with the specificities of the goods produced in the farms (in general are products of first need with low price and income elasticities). Ahumada et al. (2012) developed a stochastic model to deal with these uncertainties, more robust than the deterministic models. The forms of deal with the questions related with the risks verified in the agricultural markets, in the agricultural markets, were, also, approached by Tan and Comden (2012).

On the other hand, Cardín-Pedrosa and Alvarez-López (2012) developed a model to support the decisions of the several agricultural operators based in numerous socioeconomic and environmental indicators, constructing a matrix of adequacy among the farming productions and the indicators. Moulogianni et al. (2011) generated a programming model with more than one decision operator, allowing for the possibility of contradictory criteria, as an alternative relatively to the models built based in the linear and nonlinear programming models.

In the farming plans it is important prioritize the several steps and options. For this, there are some methodologies as those developed by Thompson (2011) for the conservation and restoration of biodiversity. About the planning for the restoration in farming landscapes, Moreno-Mateos and Comin (2010) proposed an approach with four steps to support the decisions of the related operators.

The identification and the characterizations of the farms, as referred before, it is an important step for the agricultural planning. Álvarez-López et al. (2008) characterized the agricultural systems based on the farm dimension, land utilizations and type of production.

The crop succession is another important question that must be considered in the farm planning. The crop successions are technical agronomic requirements. Haneveld and Stegeman (2005) proposed a linear programming model to take into account these aspects in the agricultural planning.

The agricultural planning, considering the particularities of the sector, is indispensable to minimize some adverse characteristics, as the farming structures, the organizational debilities and the mismatches between the demand and the supply in the agricultural markets. However, construct plans for the agriculture is not easy, because the several factors that can influence the dynamics and performance of the farming activities. In any case, the planning in the agricultural has advantages at a micro level, because support the farmers in their daily decisions, as others operators related with the distribution and the commercialization, and the policymakers, considering that these plans allow obtain conclusions that may help the public institutions in the design of the policies and strategies for the sector. There many methodologies and many tools to support the elaborations of these agricultural plans, but the linear programming models continue to be interesting bases. These models have the advantages of being easy tools that permit obtain optimized and interrelated solutions. The utility of the solutions depend on the information utilized and the structure of the model.

3. The model used

The model considered in this work has as base the linear programming, however consider statistical information at the farm level, available in the FADN (2014) database, and is an extended model that pretends consider the majority of the variables and factors that may influence the farming growth and development in the farms of the European Union countries. The model was run with data, in average for the period 2007-2011, relative a representative farm built for the all European countries by the FADN (2014) for each year.

Following will be developed a generic model that can be adjusted to any context and will be applied in the fifth section with the typical structure divided in two parts (Dantzig, 2002), the objective function and the restrictions:

- Objective function (euro): Max $Z=r11x11+\ldots+r1nx1n+r21x21+\ldots+r2nx2n-c11x11-\ldots-c1nx1n--c21x21-\ldots-c2nx2n-cc11x11-\ldots-cc1nx1n-cc21x21-\ldots-cc2nx2n+s11x11+\ldots+s1nx1n+s21x21+\ldots+s2nx2n-ic11x11-\ldots-ic1nx1n-ic21x21-\ldots-ic2nx2n-x31-\ldots-x3n$

Where:

$r11,\ldots,r1n$, are crops returns per ha (cereals, protein crops, energy crops, potatoes, sugar beet, oil-seed crops, industrial crops, vegetables & flowers, fruit, citrus fruit, wine and grapes, olives & olive oil, forage crops and other crop output);

$r12,\ldots,r2n$, are livestock returns per LU (cows' milk & milk products, beef and veal, pigmeat, sheep and goats, poultrymeat, eggs, ewes' and goats' milk and other livestock & products);

$c11,\ldots,c1n$, are crops specific costs per ha (seeds and plants, fertilisers, crop protection and other crop specific costs);

$c12,\ldots,c2n$, are livestock specific costs per LU (feed for grazing livestock, feed for pigs & poultry and other livestock specific costs);

$cc11,\ldots,cc1n$, are common costs per ha (total farming overheads, machinery & building current costs, energy, contract work, other direct inputs, depreciation, total external factors, wages paid, rent paid, interest paid, taxes, vat balance excluding on investments and vat on investments);

$cc12,\ldots,cc2n$, are common costs per LU;

$s11,\ldots,s1n$, are common subsidies per ha (compensatory payments/area payments, set aside premiums, other crops subsidies, environmental subsidies, lfa subsidies, total support for rural development, other rural development payments, other subsidies, subsidies on intermediate consumption, subsidies on external factors and decoupled payments);

$s12,\ldots,s2n$, are common subsidies per LU (subsidies dairying, subsidies other cattle, subsidies sheep & goats and other livestock subsidies);

$ic11,\ldots,ic1n$, are common investment costs per ha;

$ic12,\ldots,ic2n$, are common investment costs per LU;

$x11,\ldots,x1n$, are vegetal productions expressed in ha (cereals, other field crops, energy crops, vegetables and flowers, vineyards, permanent crops, olive groves, orchards, other permanent crops, forage crops, agricultural fallows, set aside, total agricultural area out of production and woodland area);

$x21,\ldots,x2n$, are livestock activities expressed in LU (dairy cows, other cattle, sheep and goats, pigs and poultry);

$x31,\ldots,x3n$, are several buying activities (buying of labour, etc).

Subject to

- Restrictions:

  - All vegetal activities (ha): x11+…+x1n<=b1 (where b1 is the availability of ha);

  - All livestock productions (LU): x21+…+x2n<=b2 (b2 is the availability of LU);

  - Labour needs (hours): a11x11+…+a1nx1n+…<=b3+x31 (a11,…,a1n are matrix designations and are needs per unit of labour, b3 is the total labour existent in the farm and x31 is a labour buying activity);

  - Total fixed assets constraint (euro): a21x11+…+a2nx1n+…<=b4 (a21,…,a2n are matrix designations and are request per unit of total fixed assets and b4 is the total fixed assets existent in the farm)

  - The following equations that may constructed can be similar to the last two restrictions and in in this work are relative to issues as the next, respectively: gross investment, subsidies on investments, total subsidies on crops, total subsidies on livestock, environmental subsidies, lfa subsidies, total support for rural development, other rural development payments, other subsidies, subsidies on intermediate consumption, subsidies on external factors, decoupled payments, machinery & building current costs, energy, depreciation, wages paid, rent paid, interest paid and taxes.

4. Data analyse

The table 1 has the values relatives to a typical European Union farm built trough averages, in this work, over the years 2007-2011, from the statistical information available in the Farm Accountancy Data Network, where was built typical farms to each one country and for the all countries over the last decades.

The values in the table 1 reveal that a typical European Union farm use 3584,3 hours a year of labour, the majority unpaid, in 31,2 ha of utilized agricultural area and with 25,2 livestock units. The majority of this area is occupied with cereals and forage crops and the most important livestock productions are the dairy cows and other cattle and the pigs.

This farm has a total output of 59551,4 euro, where the majority is obtained with crops productions (31287,8 euro). The crop activities with more total output are the cereals, the vegetables & flowers and the wine and grapes. In the livestock production, the total output comes from, namely, the cows´milk & milk products, pigmeat and beef and veal.

The farming system, considered here, needs inputs in a total of 53156,4 euro, where the majority are intermediate consumption (31287,8 euro). In the crop productions are the fertilizers (3280,8 euro), the seeds and plants (2496,4 euro) and the crop protection products (2142,8 euro) that consume relevant inputs. In the livestock productions a significant part of the inputs come from the feed for grazing livestock (6031,0 euro) and the feed for pigs & poultry (4898,6 euro). The depreciation (8081,2 euro), the wages paid (4969,8 euro) and the energy (4232,8 euro) represent a relevant part of the common costs.

The farm taking into account in this work has a farm net income of 16780,0 euro and a total fixed assets of 231906,4 euro, where the large part is for the land, permanent crops & quota (154809,8 euro) followed by the buildings (38924,4 euro). These farmers invest 8395,4 euro per year, in average.

Table 1. Characteristics of the typical European Union farm

Labour (hours), Area (ha) and livestock (LU)		Total, crops and livestock outputs (euro)		Specific and common crops and livestock inputs (euro)		Economic results, fixed assets and subsidies (euro)	
Labour input	3584,3	Total output	59551,4	Total Inputs	53156,4	Farm Net Income	16780,0
Unpaid labour input	2780,1	Total output crops & crop production	31287,8	Total intermediate consumption	35831,4	Total fixed assets	231906,4
Paid labour Input	804,2	Total crops output / ha	1041,2	Total specific costs	21851,4	Land, permanent crops & quotas	154809,8
Total Utilised Agricultural Area	31,2	Cereals	9639,6	Specific crop costs / ha	288,4	Buildings	38924,4
Cereals	11,8	Protein crops	184,4	Seeds and plants	2496,4	Machinery	28603,4
Other field crops	3,5	Energy crops	182,8	Seeds and plants home-grown	205,0	Breeding livestock	9569,0
Energy crops	0,2	Potatoes	1302,4	Fertilisers	3280,8	Gross Investment	8395,4
Vegetables and flowers	0,3	Sugar beet	788,6	Crop protection	2142,8	Total subsidies - excluding on investments	10591,0
Vineyards	0,6	Oil-seed crops	1934,2	Other crop specific costs	1139,8	Total subsidies on crops	567,8
Permanent crops	1,4	Industrial crops	346,0	Specific livestock output / LU	503,8	Compensatory payments/area payments	181,2
Olive groves	0,7	Vegetables & flowers	6158,2	Feed for grazing livestock	6031,0	Set aside premiums	4,6
Orchards	0,7	Fruit	2113,6	Feed for grazing livestock home-grown	2187,2	Other crops subsidies	367,4
Other permanent crops	0,0	Citrus fruit	465,0	Feed for pigs & poultry	4898,6	Total subsidies on livestock	612,6
Forage crops	12,4	Wine and grapes	3599,0	Other livestock specific costs	1844,8	Subsidies dairying	68,8
Agricultural fallows	0,7	Olives & olive oil	1340,8	Forestry specific costs	16,6	Subsidies other cattle	339,6
Set aside	0,5	Forage crops	2120,0	Total farming overheads	13980,2	Subsidies sheep & goats	70,8
Total agricultural area out of production	1,2	Other crop output	1295,6	Machinery & building current costs	3221,0	Other livestock subsidies	133,4
Woodland area	1,2	Total output livestock & livestock products	25167,2	Energy	4232,8	Environmental subsidies	983,0
Total livestock units	25,2	Total livestock output / LU	987,8	Contract work	2548,4	LFA subsidies	671,8
Dairy cows	4,8	Change in value of livestock	56,6	Other direct inputs	3978,2	Total support for rural development	1833,4
Other cattle	7,8	Cows' milk & milk products	9877,0	Depreciation	8081,2	Other rural development payments	178,4
Sheep and goats	2,7	Beef and veal	4405,2	Total external factors	9243,8	Other subsidies	650,8
Pigs	6,9	Pigmeat	5373,6	Wages paid	4969,8	Subsidies on intermediate consumption	195,2
Poultry	2,9	Sheep and goats	1069,6	Rent paid	2538,0	Subsidies on external factors	55,4
		Poultrymeat	1446,4	Interest paid	1735,8	Decoupled payments	6672,4
		Eggs	856,8	Taxes	651,8		
		Ewes' and goats' milk	982,8	VAT balance excluding on investments	290,4		
		Other livestock & products	1155,8	Subsidies on investments	434,0		
		Other output	3096,4	VAT on investments	281,0		

The total subsidies, excluding on investments, represent 10591,0 euro, where the majority are decoupled payments (6672,4 euro). The total subsidies for the crops represent 567,8 euro and for the livestock productions 612,6 euro. The environmental subsidies are 983,0 euro and the total support for rural development are 1833,4 euro.

From this data analyse the cereals and the bovine productions are the more highlighted productions in the European Union farms. The fertilizers, the crop protection and seeds and plants are the determinant specific costs in the crop productions and the feed the input that consume a significant part of the specific costs in the livestock activities. The wages, the depreciation and the energy are relevant common costs and the decoupled payments the relevant subsidies, excluding on the investments. The subsidies on the investments represents in these farms 434,0 euro per year, what seems to be few relevant comparatively with the values of the investment and with the dimension of the total output and the farm net income referred before and presented in the table 1.

5. The results

The results presented in the following tables were obtained through the Lingo (2015) optimization software, based in the linear programming model presented in the section 3 of this work and pretend to be a simulation, among many others.

In those tables:

- X11, x12, x13, x4, x15, x16, x17 and x18 represents, respectively in ha, the cereals, energy crops, vegetables and flowers, vineyards, olive groves, orchards, forage crops and other field crops.

- x21, x22, x23 and x24 are, respectively in LU, the cows, sheep and goats, pigs and poultry and other livestock products.

- The rows represent, respectively, the objective function and the following restrictions: total area, total livestock, unpaid labour, paid labour, total fixed assets, gross investment, subsidies on investments, total subsidies on crops, total subsidies on livestock, environmental subsidies, lfa subsidies, total support for rural development, other rural development payments, other subsidies, subsidies on intermediate consumption, subsidies on external factors, decoupled payments, machinery & building current costs, energy, depreciation, wages paid, rent paid, interest paid and taxes.

In the tables the value is the solution for each variable, the reduced cost is the reduction per unit in the optimized value if the correspondent variable was used, slack or surplus is the difference among the availabilities in each constraint and the used by the model for the solution presented and the dual prices or shadow prices are the gain in the optimized value per any unit more of the correspondent factor.

The table 2 shows that the more profitable agricultural activity in the European Union countries is the vegetables and flowers that in an optimized solution will occupied 30,8 ha. The productions did not select with more reduced costs are, respectively, the other livestock products (33344,48 euro) followed by the others animal productions and by the forage crops and the cereals. The more limiting factor is the subsidies on external factors and the factor where the slack or surplus have a higher value are the total fixed assets. In the global the model was optimized with 694602.1 euro for the objective function.

In the table 3, with the same model but without the subsidies in the objective function, the results are very similar, the only difference is in the value of the objective function that decrease lightly and in this case is 682962.0 euro.

The tables 4 and 5 present results for models similar with those used, respectively, for the results showed in the tables 2 and 3. In these cases the models were extended with more twelve restrictions to limit, respectively, each activity considered to the dimension of the actual context in the European Union.

The results in the table 4 presents that was chosen the vegetables and flowers (0,3 ha), vineyards (0,6 ha) and the orchards (0,7 ha). In this case the limiting factor is the area of these three crop productions. The value maximized of the objective function for these conditions is 10784.21 euro.

The values showed in the table 5, with limits for the dimension of each production and without subsidies in the objective function, are very similar with those presented in the table 4, including the value for the objective function that in this case is 10179.09 euro.

Table 2. Optimized results based in the linear programming model

Variable	Value	Reduced Cost
X11	0.000000	23721.80
X12	0.000000	23608.70
X13	30.77778	0.000000
X14	0.000000	18205.10
X15	0.000000	22647.60
X16	0.000000	20574.30
X17	0.000000	24370.00
X18	0.000000	23573.60
X21	0.000000	28764.88
X22	0.000000	29128.48
X23	0.000000	29614.48
X24	0.000000	33344.48
X3	0.000000	6.200000
Row	**Slack or Surplus**	**Dual Price**
1	694602.1	1.000000
2	0.4222222	0.000000
3	25.20000	0.000000
4	40.87778	0.000000
5	10.13333	0.000000
6	3329.078	0.000000
7	119.2556	0.000000
8	6.188889	0.000000
9	7.644444	0.000000
10	612.6000	0.000000
11	13.50000	0.000000
12	10.07778	0.000000
13	26.74444	0.000000
14	2.966667	0.000000
15	10.62222	0.000000
16	1.300000	0.000000
17	0.000000	12537.94
18	95.18889	0.000000
19	44.73333	0.000000
20	59.33333	0.000000
21	115.9111	0.000000
22	69.97778	0.000000
23	35.76667	0.000000
24	24.55556	0.000000
25	8.544444	0.000000

Table 3. Optimized results based in the linear programming model (without subsidies in the objective function)

Variable	Value	Reduced Cost
X11	0.000000	23721.80
X12	0.000000	23608.70
X13	30.77778	0.000000
X14	0.000000	18205.10
X15	0.000000	22647.60
X16	0.000000	20574.30
X17	0.000000	24370.00
X18	0.000000	23573.60
X21	0.000000	28773.33
X22	0.000000	29136.93
X23	0.000000	29622.93
X24	0.000000	33352.93
X3	0.000000	6.200000
Row	**Slack or Surplus**	**Dual Price**
1	682962.0	1.000000
2	0.4222222	0.000000
3	25.20000	0.000000
4	40.87778	0.000000
5	10.13333	0.000000
6	3329.078	0.000000
7	119.2556	0.000000
8	6.188889	0.000000
9	7.644444	0.000000
10	612.6000	0.000000
11	13.50000	0.000000
12	10.07778	0.000000
13	26.74444	0.000000
14	2.966667	0.000000
15	10.62222	0.000000
16	1.300000	0.000000
17	0.000000	12327.83
18	95.18889	0.000000
19	44.73333	0.000000
20	59.33333	0.000000
21	115.9111	0.000000
22	69.97778	0.000000
23	35.76667	0.000000
24	24.55556	0.000000
25	8.544444	0.000000

Table 4. Optimized results based in the linear programming model, with limits for the dimension of the crop and livestock productions based in the European reality

Variable	Value	Reduced Cost
X11	0.000000	1153.500
X12	0.000000	1040.400
X13	0.3000000	0.000000
X14	0.6000000	0.000000
X15	0.000000	79.30000
X16	0.7000000	0.000000
X17	0.000000	1801.700
X18	0.000000	1005.300
X21	0.000000	1181.400
X22	0.000000	1545.000
X23	0.000000	2031.000
X24	0.000000	5761.000
X3	0.000000	6.200000
Row	**Slack or Surplus**	**Dual Price**
1	10784.21	1.000000
2	29.60000	0.000000
3	25.20000	0.000000
4	2637.700	0.000000
5	762.9200	0.000000
6	220023.7	0.000000
7	7965.160	0.000000

8	411.7600	0.000000
9	538.6800	0.000000
10	612.6000	0.000000
11	932.6000	0.000000
12	637.4000	0.000000
13	1739.480	0.000000
14	169.2800	0.000000
15	617.5200	0.000000
16	185.1200	0.000000
17	52.52000	0.000000
18	6330.480	0.000000
19	3055.880	0.000000
20	4015.840	0.000000
21	7667.120	0.000000
22	4715.080	0.000000
23	2407.920	0.000000
24	1646.840	0.000000
25	618.3600	0.000000
26	11.80000	0.000000
27	0.2000000	0.000000
28	0.000000	22568.30
29	0.000000	4363.200
30	0.7000000	0.000000
31	0.000000	1994.000
32	12.40000	0.000000
33	4.700000	0.000000
34	12.60000	0.000000
35	2.700000	0.000000
36	9.800000	0.000000
37	0.2000000	0.000000

Table 5. Optimized results based in the linear programming model, with limits for the dimension of the crop and livestock productions based in the European reality (without subsidies in the objective function)

Variable	Value	Reduced Cost
X11	0.000000	1531.700
X12	0.000000	1418.600
X13	0.3000000	0.000000
X14	0.6000000	0.000000
X15	0.000000	457.5000
X16	0.7000000	0.000000
X17	0.000000	2179.900
X18	0.000000	1383.500
X21	0.000000	1652.100
X22	0.000000	2015.700
X23	0.000000	2501.700
X24	0.000000	6231.700
X3	0.000000	6.200000
Row	**Slack or Surplus**	**Dual Price**
1	10179.09	1.000000
2	29.60000	0.000000
3	25.20000	0.000000
4	2637.700	0.000000
5	762.9200	0.000000
6	220023.7	0.000000
7	7965.160	0.000000
8	411.7600	0.000000
9	538.6800	0.000000
10	612.6000	0.000000
11	932.6000	0.000000
12	637.4000	0.000000
13	1739.480	0.000000
14	169.2800	0.000000
15	617.5200	0.000000
16	185.1200	0.000000
17	52.52000	0.000000
18	6330.480	0.000000
19	3055.880	0.000000
20	4015.840	0.000000

21	7667.120	0.000000
22	4715.080	0.000000
23	2407.920	0.000000
24	1646.840	0.000000
25	618.3600	0.000000
26	11.80000	0.000000
27	0.2000000	0.000000
28	0.000000	22190.10
29	0.000000	3985.000
30	0.7000000	0.000000
31	0.000000	1615.800
32	12.40000	0.000000
33	4.700000	0.000000
34	12.60000	0.000000
35	2.700000	0.000000
36	9.800000	0.000000
37	0.2000000	0.000000

6. Conclusions

The literature review showed that the new technologies, namely those related with the geographic informatics systems, are interesting supports, considered, by many authors, for the agricultural planning. But, there are many others methodologies referred in the literature, as the mathematical models based on several frameworks, as the linear programming models, used as supports for the farmer’s decisions.

This literature revision, also, reveal the importance of the farming planning for the agricultural performance in the economic growth and development processes, considering the specificities of this economic sector.

The data description shows that the typical farms in the European Union countries, over the period 2007-2011, have 31,2 ha and 25,2 livestock units. The cereals and the forage crops are the relevant vegetal productions and the dairy cows, other cattle and pigs are the determinant livestock activities. The fertilizers, crop protection products and seeds and plants represent a great part of the crop specific costs and the feed an important portion of the livestock specific costs. The depreciations, energy and the wage paid represent significant common costs in the European Union farms. A great portion of the subsidies, excluding on investments, come from the decoupled payments, the single area and the single farm payments created after the Common Agricultural Policy reform of 2003.

The simple model constructed (may be used by the farmers) based on the linear programming methodologies is an interesting supports for the farmer’s decisions and farm management, as well for the public institutions and others operators that work with the agricultural sector. This model uses data at farm level for the all European Union countries and considers, in a disaggregated way, the majority of the factors and variables that can influence the evolution and organization of the agricultural sector in the Europe.

The results, obtained with a simulation of the model among many others that be realized, show that the vegetables and flowers are the more profitable agricultural activities in the European Union countries followed by the vineyards and orchards. The maximized value of the objective function when the model is optimized only with vegetables and flowers is 694602.1 euro, very different of the actual economic results verified in the European farms. Of course, this is a theoretical scenario, but could be a base for the strategies design. On the other hand, the subsidies do not influence the optimization process and few influence the maximized value of the objective function. It will be important in future researches complement these results with others obtained with another methodology.

References

Ahumada, O. and Villalobos, J.R. (2011). *Operational model for planning the harvest and distribution of perishable agricultural products. Int. J. Production Economics 133*: 677–687.

Ahumada, O.; Villalobos, J.R.; Mason, A.N. (2012). *Tactical planning of the production and distribution of fresh agricultural products under uncertainty. Agricultural Systems 112*: 17–26.

Álvarez-López, C.J.; Riveiro-Valiño, J.A.; Marey-Pérez, M.F. (2008). *Typology, classification and characterization of farms for agricultural production planning. Spanish Journal of Agricultural Research 6*(1): 125-136.

Bakhtiari, A.; Navid, H.; Mehri, J.; Berruto, R.; Bochtis, D. D. (2013). *Operations planning for agricultural harvesters using ant colony optimization. Spanish Journal of Agricultural Research 11*(3): 652-660.

Bryan, B.A.; King, D.; Ward, J.R. (2011). *Modelling and mapping agricultural opportunity costs to guide landscape planning for natural resource management. Ecological Indicators 11*: 199–208.

Bruin, S.; Lerink, P.; La Riviere, I.J.; Vanmeulebrouk, B. (2014). *Systematic planning and cultivation of agricultural fields using a geo-spatial arable field optimization service: Opportunities and obstacles. Biosystems Engineering 120*: 15-24.

Cardín-Pedrosa, M. and Alvarez-López, C.J. (2012). *Model for decision-making in agricultural production planning. Computers and Electronics in Agriculture 82*: 87–95.

Coopersmith, E.J.; Minsker, B.S.; Wenzel, C.E.; Gilmore, B.J. (2014). *Machine learning assessments of soil drying for agricultural planning. Computers and Electronics in Agriculture 104*: 93–104.

Dantzig, G.B. (2002). *Linear Programming. Operations Research 50*(1): 42-47.

Erickson, D.L.; Lovell, S.T.; Méndez, V.E. (2013). *Identifying, quantifying and classifying agricultural opportunities for land use planning. Landscape and Urban Planning 118*: 29– 39.

FADN (2014). *Several statistics*. European Commission.

Haneveld, W.K.K. and Stegeman, A.W. (2005). *Crop succession requirements in agricultural production planning. European Journal of Operational Research 166*: 406–429.

Lingo (2015). *Optimization software*. Lindo Systems Inc.

Moreno-Mateos, D. and Comin, F.A. (2010). *Integrating objectives and scales for planning and implementing wetland restoration and creation in agricultural landscapes. Journal of Environmental Management 91*: 2087-2095.

Moulogianni, C.; Bournaris, T.; Manos, B. (2011). *A bilevel programming model for farm planning in nitrates sensitive agricultural areas. New Medit 4*: 41-48.

Paster, E. (2004). *Preservation of Agricultural Lands Through Land Use Planning Tools and Techniques. Natural Resources Journal 44(*1): 283-318.

Pearson, C.J. (2013). *Planning for agricultural sustainability. International Journal of Agricultural Sustainability 11(*1): 1-3.

Rosa, D.L. and Privitera, R. (2013). *Characterization of non-urbanized areas for land-use planning of agricultural and green infrastructure in urban contexts. Landscape and Urban Planning 109*: 94– 106.

Russo, P.; Tomaselli, G.; Pappalardo, G. (2014). *Marginal periurban agricultural areas: A support method forlandscape planning. Land Use Policy 41*: 97–109.

Saroinsong, F.; Harashina, K.; Arifin, H.; Gandasasmita, K.; Sakamoto, K. (2007). *Practical application of a land resources information system for agricultural landscape planning. Landscape and Urban Planning 79*: 38–52.

Tan, B. and Comden, N. (2012). *Agricultural planning of annual plants under demand, maturation, harvest, and yield risk. European Journal of Operational Research 220*: 539–549.

Thompson, B.A. (2011). *Planning for Implementation: Landscape-Level Restoration Planning in an Agricultural Setting. Restoration Ecology 19(*1): 5–13.

Zhou, K.; Jensen, A.L.; Sørensen, C.G.; Busato, P.; Bothtis, D.D. (2014). *Agricultural operations planning in fields with multiple obstacle areas. Computers and Electronics in Agriculture 109*: 12–22.