AN APPLICATION OF POSITIVE MATHEMATICAL PROGRAMMING TO ANALYSE THE EFFECTS OF THE MEASURES ENVISAGED IN AGENDA **2000** ON FARMS IN A WINE PRODUCING SPANISH REGION

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Summary

This work constitutes a first approach to study the effects of the reform of the Common Market Organisation for Wine, together with the measures envisaged in "Agenda 2000" for arable crops, on a representative farm located in Castilla la Mancha. The model has been constructed from a sample of 113 agricultural holdings analysed by the Spanish Ministry of agriculture, Fisheries and Food (MAPA) in 1996/97. The study was carried out by means of a multiperiod model in which the objective function is non-linear, estimated from the actual crop allocations made by farmers in 1996/97 utilising Positive Mathematical Programming techniques.

Assuming the hypothesis that neither the cropping patterns nor the quality of the wine produced will change in this region, the first results seem to show that the implementations of the reforms aforementioned, if only the criterion of economic profitability is taken into account, would lead to a reduction in the surface under vines.

1. INTRODUCTION

The aim of this work is to analyse the possible short and medium term effects of certain agricultural policies, in particular those referring to the Common Market Organisations (CMO) for Cereals, Oilseeds and Protein (COP) Crops and Wine, on production decisions of a representative farm of those in Castilla la Mancha, in which non-irrigated arable crops (cereals, oilseeds and protein crops) and perennial crops (vines and olives) are grown.

In the working document "Situation and Prospects: Wine" (European Commission, 1998:21), the importance of the regional dimension of viticulture is stressed. In Castilla la Mancha the vineyard occupies 10% of the total Utilised Agricultural Area (UAA), accounting for 50% of the total vineyard in Spain and 16% of that in the EU. In this region, the area devoted to table wine production accounts for between 25% and 50% of that used for total wine production.

This work is a first analysis of the effects of the measures of vine uprooting and the extent to which these decisions might be influenced by the reform of the Common Market Organisation for Cereals, Oilseeds and Protein Crops[1]. This analysis has been carried out using a multiperiod

model, with a quadratic specification of the variable cost functions, obtained applying Positive Mathematical Programming techniques.

2. ASPECTS OF THE CAP INCLUDED IN THE MODEL

Due to the crops grown in the agricultural holdings recorded in the base year, the agricultural policy measures, amongst all to be reformed, that most affect the production decisions on farm, are the reform of the Common Market Organisations for Cereals, Oilseeds and Protein Crops and for Wine[2]. The measures are briefly described below.

2.1. Common Market Organisation for Cereals, Oilseeds and Protein Crops.

In July 1997 the reform of the Common Market Organisation for Cereal, Oilseed and Protein (COP) Crops was proposed, within the framework of Agenda 2000. The changes would come into effect from the cropping year 2000/01 onwards and are outlined in table 1.

TABLE 1: Comparison of the ex ante (1996/97) and ex post (2000/01) policy scenarios for the COP crops.

	1996/97	**2000/01**
Echange ratio	165.195 peseta/ECU	165.750 peseta/ECU
Intervention price for cereals	119.19 ECU/Table	95.35 ECU/t
Cereal compensatory payments	54.34 ECU/Table	66 ECU/t
Oilseed compensatory payments	54.34 ECU/t (rég. Simplific.) 94.24 ECU/t (rég. General)	66 ECU/t
Compulsory set-aside rate	12%	0%

[1] Prior to the CAP Reform representative farm models have been utilised to study the effects of EEC grubbing up policy in Castilla la Mancha (JÚDEZ et al., 1989)
[2] Although the Common Market Organisation for Olive Oil has also been reformed recently, it has not been modelled in this work, assuming that the land devoted to olive production on farm remains unchanged.

Compulsory + voluntary set-aside	?30%	?30%
Payments for set-aside land	68.83 ECU/Table	66 ECU/t

Since the base year data corresponds to 1996/97 and the terms of the reform were not announced until 1997/98 it is necessary to distinguish two periods, in which farmers adapt their cropping decisions to the current available information. In both of them, farmers are supposed to reallocate the available land among crops seeking to attain a stationary state. The first multiperiod model, prior to the introduction of the changes aforementioned, begins from the marketing year 1997/98, reaching the stationary state in 2001/02. The second model, covers the period from 1998/99 onwards, and it takes into account the reforms of the CMOs[3].

2.1.Common Market Organisation for Wine

The use of permanent abandonment premiums in the past has led to a loss of vine-growing potential which, together with the transfer of replanting rights to other Autonomous Regions, may endanger the sector. This explains the concern of the local government to prevent the permanent abandonment and the transfer of rights to other regions from taking place. Indeed, in the 1996/97 and 1997/98 marketing years no permanent abandonment has been allowed in Castilla la Mancha, and therefore it is not included in the model in the mention period. Moreover, it is likely that even if new grubbing up premiums are implemented in the EU from the 1998/99 marketing year, as proposed in the reform of the CMO for Wine, the Autonomous Region of Castilla la Mancha will continue to exclude itself from their scope. For this reason, the subsidy to permanent abandonment of vineyard envisaged in the CMO reform for future years has not been modelled.

On the other hand, we do include in the models the possibility of transfers of replanting rights, receiving in exchange the amount of 200,000 pta/hectare (estimated market value of replanting rights at present, although this amount is highly variable and depends on farm yields). The consequence of transferring the rights to another agricultural holding is the impossibility of growing any vines on the area affected and hence the cost of uprooting must be deducted from the estimated market value.

Since no quota for new vine planting has been assigned to Castilla la Mancha, it will be assumed that any planting in the representative farm modelled will be in replacement of vineyard on another farm, through the corresponding transfer of replanting rights. This activity involves the cost of purchasing these rights, p.e. their estimated market value of 200,000 pta/hectare. Vine planting has been unlimited up to the present year, but a maximum of 20 hectares per farm has been set from 1999/00[4].

[3] The model allows the farm whether to join the general scheme or not in the period under study. Given the characteristics of the representative farm, it is not possible to join the simplified scheme.

[4] At present a modification of Royal Decree 2658/1996 is under discussion. TI-ds Royal Decree regulates the system of licenses for planting vines and provides that "licenses for replacement plantings will be limited by each Autonomous Region to the annual addition of a maximum of 20 hectares per individual farm and in the case of associations of farmers, 20 hectares for each associate with a maximum of 60 hectares".

In addition, the creation of national and/or regional reserves in envisaged, and to these will be allotted, among others, the replanting rights of producers who will receive in exchange a monetary payment for their sale. It is left to the Member States to define the criteria applicable for establishing the amount of the monetary purchase payment, which may vary in accordance with the final product. The rights may also be assigned at no charge to young farmers.

The creation of these reserves involves that the transfer of rights between private individuals may not take place directly and therefore there will not be a market price for these rights as there is at present. Member States will regulate it after the reform comes into effect, which is due to be in 2000/01[5]. In this study, the impact of different amounts of monetary payment will be analysed.

3. DATA AND METHODOLOGY

3.1.Characteristics of the representative farm

The representative farm model is built using data from a study carried out by the Spanish Ministry of Agriculture, Fisheries and Food (MAPA, 1997) on the analysis of the technical and economic results obtained in 1996 on 113 farms in Castilla la Mancha, 59 of which had non-irrigated areas under vines. From the sample data, the average land allocated to each crop has been calculated, assigning the resulting figures to the crop allocations on the representative farm in the base year. The representative farm covers an area of 51.34 hectares of non-irrigated land, of which 18.8 hectares are devoted to permanent crops (10 hectares of olives and 8.8 hectares of vines).

Variable crop costs, prices and yields have been obtained from the aforementioned study. Variable costs include direct costs (seeds and plants, fertilisers and pesticides), machinery (fuel, lubricants and maintenance costs) and hired labour. A summary of the data is shown in Table 2.

TABLE 2: Crop variable costs (peseta/hectare), yields (kg/hectare) and prices (peseta/hectare) used in the model

	Prices (peseta/kg)	**Yields (kg/hectare)**	**Variable costs (peseta/hectare)**
Wheat	26,12	1.887	22.860
Barley	21,04	2.463	28.776
Lentils	63,91	757	20.803
Peas	25,63	1.017	23.192
Vetch	24,42	666	17.885
Sunflower	25,89	716	13.800
Olives	27,22	37.337	16.755
Vines in production	36,63	4.058	41.948
1st year vines[1]	-	-	84.400
2nd year vines	-	-	7.040

[5] In fact it is possible that the reform will come into effect in the 1999/2000 since in principle there seems to be consensus on its application

3rd year vines	-	-	21.780

Source: MAPA, 1997.

[1] Variable cost of unproductive vines (i.e., from the year in which the plantation is established until the third year) have been obtained from JUDEZ et al. (1989)

3.2. Estimation of the variable cost functions from the base year data

First, a static linear model was constructed (MODEL 1) which reproduces the base year results of the representative farm, by means of a constraint set that forces the solution of the model to be equal to the actual crop allocation (calibration constraints). From this model, and assuming that the situation in the base year corresponds to an economic optimum, the marginal crop costs can be obtained. Therefore, by choosing a specification of the variable cost function (a quadratic one in our case) and making the marginal cost of each crop at the observed levels equal to those obtained in the linear model solution, it is possible to estimate one parameter of each function. By eliminating the calibration constraints and replacing the linear variable cost functions with the quadratic ones, the model reproduces the situation of the base year with no need for any additional constraints.

The basis of the method can be outlined as follows:

Let $\tilde{\mathbf{x}} = (x_1, x_2, .., x_k ,.. , x_q)'$ be the vector of the activity levels of a non-linear program, in which the objective function is strictly concave and the constraints are linear:

<u>Problem 1</u> max $g(\tilde{\mathbf{x}}) = \overset{q}{\underset{k?1}{?}} h_k(\tilde{\mathbf{x}})x_k$

s.t. $\tilde{\mathbf{A}}\tilde{\mathbf{x}} ? \tilde{\mathbf{b}}$

$\tilde{\mathbf{x}} ? 0$

where

$\tilde{\mathbf{A}}$: the n x q matrix of technical coefficients

$\tilde{\mathbf{b}}$: the vector of maximum availability of resources.

The calibration procedure is aimed at estimating the coefficients of the functions $h_k(\tilde{\mathbf{x}})$ so that $x_1 = x_1^0$, $x_2 = x_2^0$, ..., $x_q = x_q^0$ is the optimal solution of the non-linear program. The vector $(x_1^0, ..., x_q^0)$ represents the levels of the activities observed in the base year.

By taking exclusively into consideration the variables x_k whose observed values are different from zero in the base year (which without any loss of generality are assumed to be the first p variables) and the binding constraints at the optimal level (which are also supposed to be the first m constraints), problem 1 can be expressed as follows:

<u>Problem 2</u> max $g(\mathbf{x}) = \overset{p}{\underset{k?1}{?}} h_k(\mathbf{x})x_k$

s.t. $\mathbf{Ax} = \mathbf{b}$

$\mathbf{x} > 0$

where,

x: vector of p non-zero activities, x_k, observed in the base year

A: n x p matrix of technical coefficients a_{ik}

b: vector of maximum availability of the first m resources.

The solution for the calibration problem can be deduced from problem 2, applying the Kuhn-Tucker conditions. The unknown parameters of $h_k(\mathbf{x})$ can be obtained from the following expression:

$$(1) \qquad \frac{?}{?x_k} \mathop{?}_{k?1}^{p} h_k(x_1, x_2,..., x_p)x_k \Big|_{x?x^0} ? \mathop{?}_{i?1}^{m} a_{ik}?_i^* \qquad k = 1,2...,p$$

where,

$\frac{?}{?x_k} \mathop{?}_{k?1}^{p} h_k(x_1, x_2,..., x_p)x_k \Big|_{\mathbf{x}?\mathbf{x^0}}$: Partial derivative of $g(\mathbf{x})$ with respect to x_k at $\mathbf{x} = \mathbf{x^0}$

$?_i^*$: Opportunity cost at the optimal solution associated to the *i*th constraint

The proof is in Júdez *et al* (1998). In this case:

$$h_k(x_1,...,x_p)x_k = (r_k - ½?_k x_k)x_k$$

where:

r_k:income per unit of activity k

$?_k$:parameter related to activity k, which calibrates the non-linear model

Therefore, equation (1) becomes in our case:

$$(2) \qquad ?_k ? \frac{r_k ? \mathop{?}_{i?1}^{m} a_{ik}?_i^*}{x_k^o}$$

If opportunity costs of resources, $?_{i,}$ at the optimal solution equal to those derived from a linear programming model [6] (as presented in Júdez et al. (1998)) whose economic function is:

$$(3) \qquad f(\mathbf{x}) = \mathop{?}_{k?1}^{p} (r_k ? d_k)x_k$$

where d_k are the unit variable costs, the following relation holds:

$$r_k ? d_k ? \mathop{?}_{i?1}^{m} a_{ik}?_i^* ? ?_{2k}^*$$

where $?_{2k}^*$ is the dual value of the k-th calibration constraint [7]. Thereby, equation (2), which determines the parameter $?_k$, can also be expressed as follows:

[6] These opportunity costs can also be estimated empirically.

[7] Constraints in the linear programming model limiting the surface or the number of heads of the activity k to the level of the base year.

$$? _k ? \frac{?^*_{2k} ? d_k}{x^o_k}$$

3.3.Multiperiod models

Given the pluri-annual nature of the agricultural policy whose effects it is wished to analyse and the pluri-annual nature of vines, multi-period models have been utilised. It is also necessary, as explained in section 2.2.l., to consider two multiperiod models: the first one, in which the measures envisaged in the Agenda 2000 are not included, and the second one, in which they are included. Both models have the same the economic function, in which the variable cost functions are determined by MODEL 1 as describe in the previous section.

The first multi-period model (which we shall call MODEL 2) covers from 1997/98 to 2001/02, and assumes the information that was available to the farmer in 1997/98 for those years, which, obviously, did not include the measures proposed in Agenda 2000 for COP crops or the reform of the CMO for Wine.

The second multiperiod model (MODEL 3) comprises from 1998/99 to 2002/02 marketing years. The initial conditions for this model are the land allocations produced by model 2 in 1997/98. This model introduces the Agenda 2000 measures for arable crops and the changes in the CMO for Wine. These basically involve a regulated market for replanting rights, which in the case of Spain, will probably limit the transfer of rights to an upper limit of 20 hectares per farm.

The correspondence between the models and the marketing years covered by each of them is shown in figure 1.

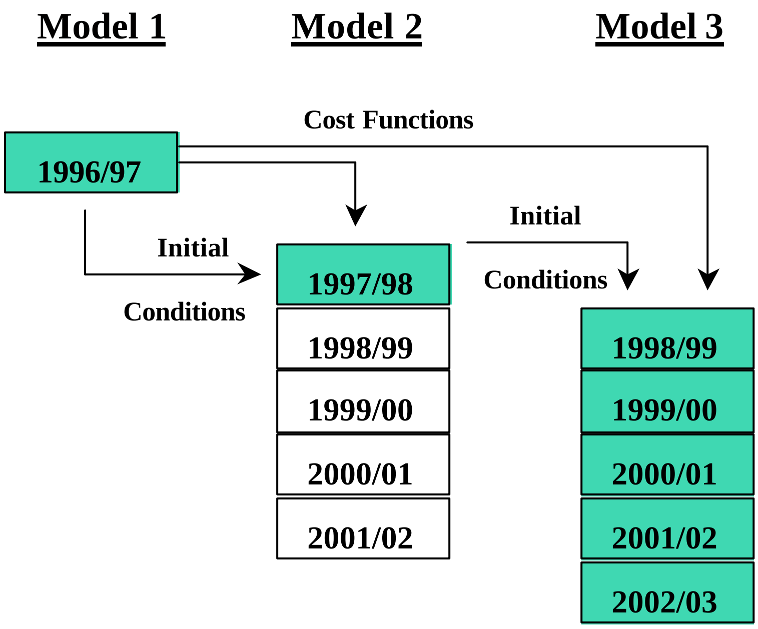
The two multiperiod models have the same structure and it will be described in detail.

Description of the multiperiod models

The period in which farmers can make adjustments to reach an equilibrium, given the information available, is assumed to be five years. The land allocations attained in the fifth year is supposed to represent an state of equilibrium, which assumed to continue indefinitely.

In year 1 the initial area under vines equals to the land devoted to vine growing in the base year (for model II) or the area obtained in 1997/98 from model II (for model III). For the following five years part or the whole of this acreage can be uprooted by selling the replanting rights to other farms, and new plantings can take place by purchasing these rights.

Figure 1. Diagram of relationships between models.



It has been assumed that the vines in full production in year 1 are E years old. Considering that the productive life of vines is V years, the vines initially under cultivation will have V-E years of productive life left, after which they will be renewed. In order to do this it will be necessary to uproot them and plant new vines. In the first and the following two years these vines are unproductive.

Activities:

Table 3 shows the activities included in the multiperiod models.

TABLE 3: List of activities.

Acronym	**Unit**	**Activity**
TRB_t	Hectares	Wheat in year t
CBD_t	Hectares	Barley in year t
LEN_t	Hectares	Lentils in year t

GUI_t	Hectares	Peas in year t
VEZ_t	Hectares	Vetch in year t
GIR_t	Hectares	Sunflowers in year t
OLI_t	Hectares	Olvives in full production in year t
VIN_t	Hectares	Vines in full production, grown for wine making, in year t
AVI_t	Hectares	Area of unprooted vines in year t

Acronym	**Unit**	**Activity**
$ROBL_t$	Hectares	Compulsory set-aside land in year t
$RVOL_t$	Hectares	Voluntary set-aside land in year t
$SUPRG_t$	Hectares	Area receiving compensatory payments in year t
$SCRG_t$	Hectares	Cereals receiving compensatory payments in year t
$SORG_t$	Hectares	Oilseeds receiving compensatory payments in year t
$SPRG_t$	Hectares	Protein crops receiving compensatory payments in year t

Since the planning horizon is 5 years, the activities included in the multi-period model will vary with sub-indices ranging from 1 to 5.

Constraints:

The constraints and right hand sides of the multi-period models are shown below.

- Limit of the farm's UAA in year t

$$\underset{i}{?}\ C_{it}\ ?\ OLI_t\ ?\ VIN_t\ ?\ AVI_t\ ?\ NV_1 t\ ?\ NV_2 t\ ?\ NV_3 t\ ?\ ROBL_t\ ?\ RVOL_t\ ?\ 51.34$$

where Cit, is the area sown of arable crop i in year t.

- Definition of the total area entitled to receive compensatory payments in year t

$$-SCRG_t - SORG_t - SPRG_t - ROBL_t - RVOL_t + SUPRG_t = 0$$

- Equilibrium for cereals between cultivated area and area receiving compensatory payments in year t

$$-TRB_t - CBD_t + SCRG_t \ ? \ 0$$

-Equilibrium for oilseeds between cultivated area and area receiving compensatory payments in year t

$$-GIR_t + SORG_t \ ? \ 0$$

-Equilibrium for protein crops between cultivated area and area receiving compensatory payments in year t

$$-GUI_t + SPRG_t \ ? \ 0$$

-Equilibrium between area entitled to receive compensatory payments and compulsory set-aside area in year t

$$-ROBL_t - R_1 \times SUPRG_t = 0$$ [8]

-Limit of total set-aside area in year t

$$-RVOL_t + ROBL_t - R_2 \times SUPRG_t \ ? \ 0$$ [9]

Economic function:

As it was pointed out above, the model allows for changes in crop allocations during a period of five years. It is assumed that the structure attained at that time will be maintained indefinitely, renewing the vineyard each V years.

The economic function of the multiperiod models is formed by the total gross annual margins, increased by the compensatory payments, during an infinite number of years, discounting them to the first year modelled. This economic function enables the evaluation of different annual and multi-period activities in a comparable manner by extending all the activities to infinite.

[8] R_1 = compulsory ser-aside rate
[9] R_2 = maximum rate of total ser-aside land

If we are dealing with an annual crop and p is the number of years in which the farmer makes changes in the land allocations in order to reach the stationary state, the terms of the economic function are given by:

$$\frac{mb_{i,t}}{(1+r)^t} \qquad si\ \ t<p$$

$$\sum_{t=p}^{\infty} \frac{mb_{i,p}}{(1+r)^t} = \frac{mb_{i,p}}{r(1+r)^{p-1}} \qquad si\ t=p$$

where $mb_{i,t}$ is the gross margin plus the compensatory payments for crop i in year t, and r the discount rate.

In the case of vineyard, it must be taken into consideration that it remains in production V years and it must then be replaced. If E is the age of the vines in 1996/97, the terms corresponding to the vines in the-objective function are determined by:

$$\frac{mb_{VIN,t}}{(1+r)^t} \qquad \text{si}\ \ t<p$$

$$\frac{mb_{VIN,p}}{r(1+r)^{V-E}}\left[(1+r)^{V-E-P+1} - 1\right] + \frac{VA(1+r)^{E-1}}{(1+r)^V - 1} \qquad si\ t = p$$

where

$$VA = -C_{NV1} - C_{AVI} - \frac{C_{NV2}}{1+r} - \frac{C_{NV3}}{(1+r)^2} + \sum_{t=4}^{V} \frac{mb_{VIN,p}}{(1+r)^{t-1}}$$

Where C_{NV1} , C_{NV2} *and* C_{NV3} are the variable costs of unproductive vines in years 1, 2 and 3 respectively. C_{NV1} is the variable costs of uprooting an hectare of vineyard and $mb_{VIN,}$, is the gross margin of vines in full production in year t.

4. RESULTS

The results obtained with the models for the period under study, in particular the land allocations, will be analysed. Furthermore we will compare the equilibrium state attained when the measures envisaged in Agenda 2000 are applied with the equilibrium reached when these measures are not implemented. Finally, different amounts of monetary payments for selling or buying vine replanting rights are simulated. This monetary payment, which must be set by the different Member States, is not yet defined, and therefore we consider that this work may represent a first attempt at evaluating the effects of this amount on farms. The monetary payments for replanting rights have been assumed to range between 50,000 and 400,000 pesetas. Table 6 presents the different land allocations among crops resulting from varying the monetary payments.

The scenarios considered before and after the possible application of Agenda 2000 are summarised in table 1. Prices, yields and variable costs have been considered to remain constant throughout the period and equal to those of the base year. A discount rate of 4% has been assumed. It has also been assumed that the sale of replanting rights generates an income of 200,000 pesetas per hectare for the seller (and therefore it is same cost for the buyer). We set out from the hypothesis that the monetary payment envisaged in the reform of the CMO for Wine in exchange for transferring replanting rights is the same as the average price before the reform, p.e. 200,000 pesetas/hectare. The obligation of uprooting the vineyard after transferring these rights generates a cost of 55,000 peseta/hectare.

4.1. Trends in crop areas over the period 1997/98 to 2002/03.

In table 4 are summarised the resulting land allocations during the period under study.

TABLE 4: Land allocations on the modelled farm. Figures in hectares.

	1996-97	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**
Wheat	0.51	0.53	0.54	0.51	0.62	0.62	0.62
Barley	21.11	22	22.12	21.22	25.22	25.22	25.54
Lentils	0.26	0.27	0.27	0.26	0.28	0.28	0.28
Peas	0.19	0.2	0.2	0.19	0.19	0.19	0.2
Vetch	1.24	1.32	1.33	1.25	1.47	1.47	1.51
Sunflower	6.22	6.77	6.84	6.29	5.08	5.08	5.27
Olives	10	10	10	10	10	10	10
Vines	8.7	8.48	8.48	8.48	8.48	7.91	7.91
Vine uprooting	0	0.22	0	0	0	0.57	0
Vine planting	0	0	0	0	0	0	0
Compulsory set aside	3.11	1.55	1.56	3.13	0	0	0
Voluntary set aside	0	0	0	0	0	0	0
Total G. S.	31.14	31.06	31.26	31.35	31.1	31.1	31.63
Cereals G.S.	21.62	22.53	22.65	21.73	25.83	25.83	26.16
Oilseed G. S.	6.22	6.77	6.84	6.29	5.08	5.08	5.27
Protein Croops G.S.	0.19	0.2	0.2	0.19	0.19	0.19	0.2

NOTE: G.S.: general scheme

The monetary payment from 2000/01 onward is assumed to be equal to the market price for the sale of rights in the 1997/98 and following campaigns.

It can be noticed that there is an increase in the area devoted to cereals (especially barley), and a reduction in the area in which oleaginous crops are grown. Since the compulsory set-aside rate is 0% from 2000/01, there is no compulsory set-aside land from that campaign on. On the other hand voluntary set-aside does not seem to be profitable on this farm. A total 0.79 hectares of the 8.7 hectares of vines initially existing on the farm are uprooted. All other crop activities register only slight changes.

4.2. Comparison of the resuits with and without Agenda 2000.

Table 5 shows a comparison of the equilibrium state reached when the measures envisaged in Agenda 2000 are applied with the state of equilibrium that would have been attained if these measures had not been implemented.

It is observed that although the area entitled to receive compensatory payments is practically the same in both situations, the proportions of cereals and oleaginous crops varies greatly from one scenario to another. This is due to the fact that in Agenda 2000 compensatory payments for cereals and oilseeds are made equal, while previously the difference was almost 40 ECU/t (see Table l). The area previously set aside (which is no longer compulsory in Agenda 2000) is assigned to other crops (cereals, mainly). Given that the initial hypothesis was that the payment for the sale of rights was the same in both scenarios, the differences in the area occupied by vineyard in the equilibrium year in the two scenarios are due exclusively to the reform of the CMO for COP Crops. It can be noticed that the extension vineyard in the equilibrium year is slightly higher when the Agenda 2000 measures are applied. However, it should be also pointed out that both in this case and when the reform is not applied, there is a reduction in the surface under vines, which is around 10% between the base year and the equilibrium year.

TABLE 5: Comparison of land allocations in the equilibrium state without Agenda 2000 and with Agenda 2000

ACTIVITY	WITHOUT AGENDA 2000 (1)	WITH AGENDA 2000 (2)	$\frac{(2) ? (1)}{(1)} ? 100$
Wheat	0.52	0.62	19 %
Barley	21.64	25.54	18 %
Lentils	0.26	0.28	8 %
Peas	0.19	0.2	5 %

Vetch	1.29	1.51	17 %
Sunflower	6.55	5.27	-20 %
Olives	10	10	0 %
Vines	7.66	7.91	3 %
Compulsory set aside	3.21	0	-100 %
Voluntary set aside	0	0	0 %
Total G. S.	32.13	31.63	-2 %
Cereals G.S.	22.17	26.16	18 %
Oilseed G. S.	6.55	5.27	-20 %
Protein Croops G.S.	0.19	0.2	5 %

4.3. Effects of a variable monetary payment in exchange for vine replanting rights.

Table 6 presents the results of applying a variable money payment of between 50,000 and 400,000 pesetas per hectare for the sale of replanting rights. It is envisaged that this payment, as it has been indicated, will come into effect from the 2000/01 marketing year.

TABLE 6: Effect of the amount of the monetary payment for replanting rights on the allocation of areas on the modelled farm in equilibrium. Figures in hectares.

Crop	**Amount of monetary payment (pesetas/hectare)**							
	50000	100000	150000	200000	250000	300000	350000	400000
Wheat	0.62	0.62	0.62	0.62	0.63	0.63	0.63	0.63
Barley	25.51	25.51	25.51	25.54	25.62	25.7	25.78	25.86
Lentils	0.28	0.28	0.28	0.28	0.28	0.28	0.29	0.29
Peas	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Vetch	1.51	1.51	1.51	1.51	1.52	1.53	1.54	1.55
Sunflower	5.25	5.25	5.25	5.27	5.32	5.37	5.42	5.47
Olives	10	10	10	10	10	10	10	10
Vines	7.97	7.97	7.97	7.91	7.77	7.63	7.49	7.34

It can be noticed in this table that the amount of the monetary payment in the interval studied has no significant influence on the land allocated to the crops modelled and the decision of uprooting or planting vines.

5. CONCLUSIONS.

When only criteria of economic profitability are taken into account, the scenarios envisaged in the reform of the CMO for Wine, combined with those envisaged in Agenda 2000 for arable crops seem to lead in this first approach to a reduction of around 10% in the area under vines existing on a representative farm of those in Castilla La Mancha whose production is oriented towards non-irrigated crops.

With currently existing technology it does not seem profitable to plant new vines, according to the data utilised in this study. However, ¡t should be pointed out that only grape production for table wines has been considered here. If replacement of these plantations with vines for quality wines were to be considered, the model might well produce different results.

The methodology used for this particular case constitutes a tool that can be used to analyse the economic benefit of uprooting or planting new vines on other representative farms and/or in other wine producing regions.

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