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Abstract

The measures applied in Castilla-La Mancha, one of Spain's autonomous regions, under the compensatory allowance scheme (CAS) in irrigable areas are provided for in Regulation (EC) No. 1257/1999 (Rural Development Regulation). The purpose of these measures is to conserve one of Spain's most important wetlands: the Tablas de Daimiel National Park, whose viability is contingent upon the amount of irrigation water drawn by the holdings located over aquifer 23, which feeds it.

New CAS measures were approved in late 2003, some of which are applicable to vineyards. Specifically, irrigated vineyards now qualify for irrigation reduction aids, for which they were not previously eligible.

The present study purposes to analyse the possible effects of the CAS measures on holdings with irrigated vineyards located over aquifer 23, bearing in mind that most of these holdings are likewise eligible for aid for COP crops (cereals, oil seed and protein crops). The analysis conducted involves simulating the results for four farm types under different COP crop aid scenarios (Agenda 2000 and Mid-term Review of the CAP) and different formulas for adhering to the CAS. Positive mathematical programming is used in the simulations.

Multivariate analysis techniques are applied to define the farm types from information gathered from a survey conducted in 2002 (taken as the base year for the study) on 51 holdings with irrigated vineyards.

The findings show that the CAS adherence formula adopted by farm types is unrelated to the type of aid envisaged for COP crops. Moreover, the new CAS measures to which the holdings adhere depend on the CAS formula in force for each one in the base year and on the intensity of vineyard irrigation.

Key words: CAP, Agri-environmental measures, Compensatory allowance scheme, Positive mathematical programming, Daimiel.

1. Introduction

CAP accompanying measures designed to compensate farmers for reducing the volume of irrigation water have been in place since 1993 for the holdings in Castilla-La Mancha located over aquifer 23. These measures, also known as the “Wetlands Plan” are intended to conserve the *Tablas de Daimiel* National Park, a UNESCO Biosphere Reserve included in the Ramsar Convention list of natural wetlands. Park viability depends on the water supplied by aquifer 23, whose piezometric level declined by 20.6 metres between 1974 and 1993 (Serna, J.; Gaviria, M.; 1995) due to the expansion of the area serviced by irrigation¹.

In 1987 the Confederación Hidrográfica del Guadiana declared aquifer 23 to be temporarily over-exploited and began to implement an irrigation reduction policy, although it was not until 1993, as noted above, that the first regulation on the compensatory allowance scheme (CAS), designed to mitigate the losses sustained due to cutbacks in irrigation, was adopted. The CAS or Wetlands Plan was in force from 1993 to 1997, as one of the European Union’s “environmental measures”, envisaged in the so-called “Environmental Regulation” (EEC 2078/92). The Wetlands Plan was subsequently extended to cover the period 1998-2002. One of the most prominent changes made in recent (2003) amendments to the measures contained in that legislation provides for the inclusion of irrigated vineyards as part of the area eligible for aid for reducing the irrigated area.

¹ According to Serna, J.; Gaviria, M., (1995), the irrigated area grew from 31,116 ha in 1974 to 126,613 ha in 1987.

The purpose of the present paper is to study the possible impact of the new measures proposed in 2003 on farms with irrigated vineyards. Given, moreover, that the Wetlands Plan measures supplement the CAP measures for COP crops, account is taken in the analysis of the various CAP alternative arrangements for these crops - namely, Agenda 2000 measures and the decoupling measures envisaged in the CAP Mid-term Review (MTR) pursuant to the EU Council proposal of September last - to ascertain whether such alternatives have an impact on the adoption of a given Wetlands Plan formula.

The analysis was conducted at the holding level using a positive mathematical programming model (Howitt, 1995) to compare the base year situation for the various farm types to the simulated results computed for each type in a number of scenarios resulting from applying the measures provided for under the Wetlands Plan and the CAP arrangements for COP crops.

The farm types were defined from data gathered from a survey conducted in 2002 (taken to be the base year for the analysis) of 51 farms with irrigated vineyards, all located over aquifer 23.

A detailed description of the agricultural policy scenarios addressed in this paper is given in section 2 below, whilst section 3 deals with the procedures followed to define the farm types. Section 4 contains a discussion of the model used to obtain the results analysed in section 5.

2. Scenarios and assumptions

The effects of the new CAS measures, together with the impact of the compensatory payments for COP crops on the different farm types considered, were analysed by comparing the base year situation to the results of the simulations run for other scenarios.

The policy measures for the base year scenario are: the 1998 CAS measures and the Agenda 2000 aids for COP crops in 2002.

The scenarios for which the results were simulated were as follows: i) 2003 CAS and Agenda 2000 COP crop aids in 2002; ii) 2003 CAS and the single farm payment with partial decoupling arrangements – 25% of the total compensatory payment for COP crops; and iii) 2003 CAS and the single farm payment with total decoupling.

The details of the two compensatory allowance schemes considered are compared in Table 1 below, while Table 2 shows the scenarios for COP crops under CAP Agenda 2000 and MTR arrangements, for both total and partial decoupling of the compensatory payments.

Furthermore, the following assumptions were adopted: i) product sales prices are in line with the prices most often reported in the survey; ii) although the modulation measures (reductions in the total compensatory payments for COP crops) are to be phased in, the simulation assumed them to be in the final phase: in other words, a 5% reduction is applied to amounts of over €5,000; iii) the fallow rate used - 28% - is the rate in effect in Castilla-La Mancha.²

² Royal Decree 3477 / 2000 (Official State Journal 30-12-2000).

TABLE 1: Characteristics of the 1998 and 2003 Wetlands Plans

1998 Wetlands Plan	2003 Wetlands Plan
Irrigated vineyards not eligible for aid	Vineyards eligible for aid
The area of fallow and set-aside fields are included when computing the volume of water that can be drawn	No provision is made for fallow land irrigation.
Reduction commitments: <ul style="list-style-type: none"> ▪ 50% reduction: maximum water consumption – 2,100 m³/ha. ▪ 70% reduction: maximum water consumption – 1,200 m³/ha-year. ▪ 100% reduction: completely forgo irrigation on the holding.. 	Reduction commitments: <ul style="list-style-type: none"> ▪ 50% reduction: maximum of 977.5 m³/ha for 2003, excepting vineyards, where the maximum consumption is 500 m³/ha. ▪ 100%: no water authorised for any use whatsoever
Aid Annual, per hectare of irrigated fields (excluding vineyards), as reported by holding Maximum amounts: <ul style="list-style-type: none"> ▪ 50% reduction: 29,850 ESP/ha (€179.40/ha) ▪ 70% reduction: 49,350 ESP/ha (€296.60/ha) ▪ 100% reduction: 68,900 ESP/ha (€414.10/ha) ▪ 50 and 70% reductions are eligible for direct aid for irrigated crops ▪ 100% reduction is eligible for direct aid for dry crops 100% reduction is incompatible with direct aid for irrigated land; holdings adhere to aid for non-irrigated land	Aid: Annual, computed from the area accredited to be entitled to irrigation water Premium per ha. <ul style="list-style-type: none"> ▪ 50% reduction: €209/ha ▪ 100% reduction: €518/ha Total aid: <ul style="list-style-type: none"> ▪ First 40 ha: 100% of Premium per ha. ▪ From 40 to 80 ha: 60% of Premium per ha. ▪ Over 80 ha: 30% of Premium per ha. 50% reduction is eligible for COP aid in irrigated land; 100% reduction is eligible for aid for non-irrigated COP crops

TABLE 2: CAP measure scenarios for COP crops

	Base year 2002	Total decoupling Single payment	Partial decoupling

			Coupled payment	Decoupled payment
Direct aid for cereals	€63/t	€63/t	€15.75/t	€47.25/t
Direct aid for protein crops	€72.5/t	€63/t	€15.75/t	€47.25/t
Protein crop premium	–	€55.57/ha	5€57/ha	–
Direct aid for grain legumes	€181/ha	€181/ha	–	€181/ha
Compulsory set-aside (Agenda 2000)	10%	–	–	–
Set-aside payment	€63/t	63€/t	–	€63/t
Compulsory set-aside provided in the Mid-term Review		Base year set-aside	Base year set-aside	

Reference yield: i) non-irrigated cereals, protein crops and set-aside: 2.1 t / ha, ii) irrigated cereals, excepting maize: 4.2 t/ha, iii) irrigated maize: 6.1t/ha, iv) protein crop and irrigated set-aside: 5.1 t/ha.

Partial decoupling, coupling of 25% of COP crop compensatory payments.

Source: Regulation (EC) 1251/1999 of 19 May 1999 and Regulation (EC) 1782/2003 of 29 September 2003.

3. Farm types

As may be deduced from the scenarios discussed in section 2 and as mentioned in the foregoing, one of the most prominent changes in the 2003 Wetlands Plan eligibility requirements compared to the plan in place in the base year is that in 2003 vineyards qualify for aid.

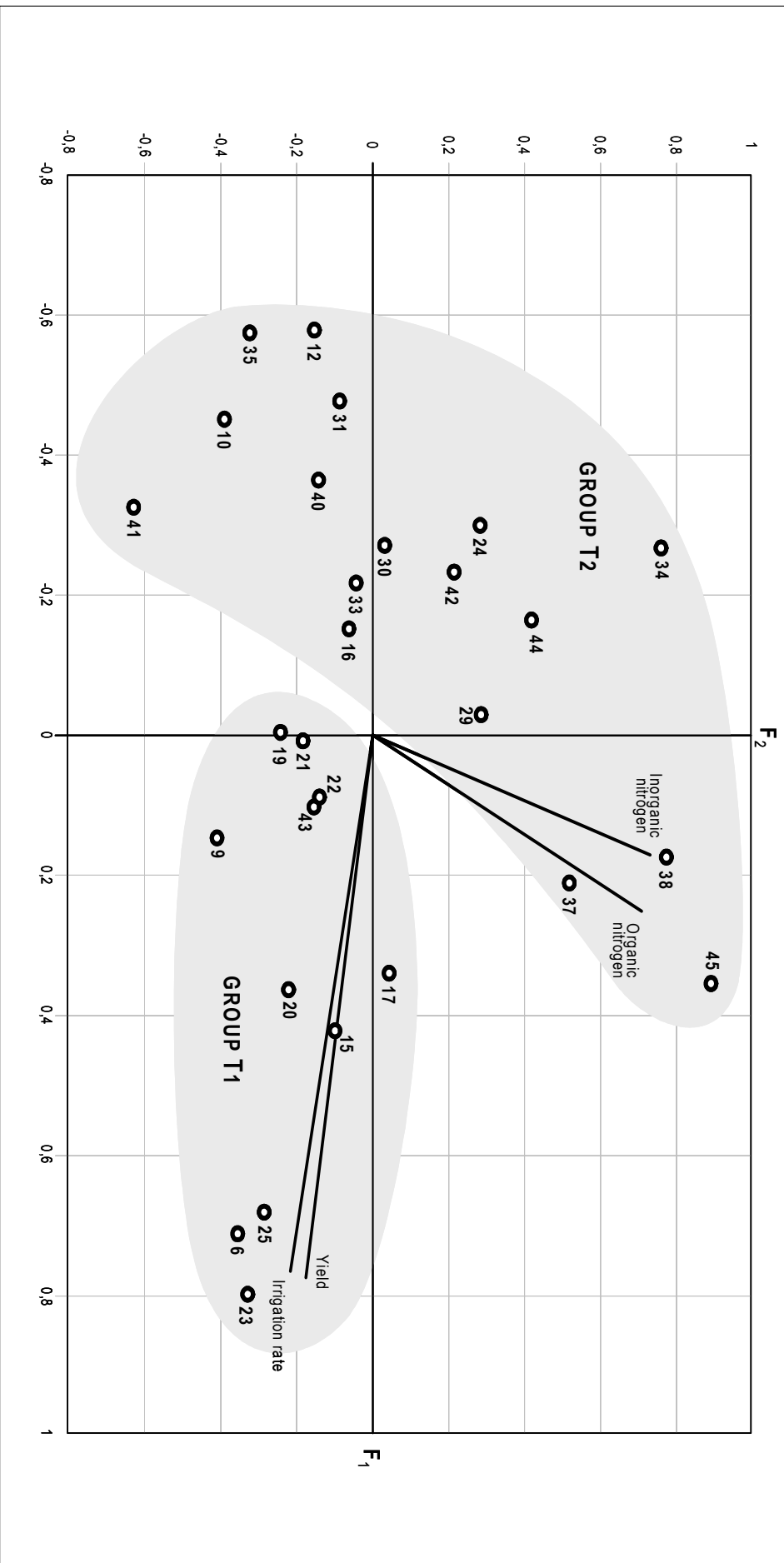
Therefore the first step in formulating a typology from the survey of 51 farms referred above was to distinguish holdings in terms of the farming technique used in irrigated land growing "airen", the predominant vineyard variety in La Mancha and practically all the holdings surveyed. The variables chosen to characterise production techniques were: yield per hectare, irrigation volume per hectare, and units of nitrogen per hectare and year in the form of organic and inorganic fertilisers. The typology was built from the 28 holdings of the 51 for which data were available for all these variables, using principal components analysis, combined with a cluster analysis.

Figure 1 shows the representation of the holdings and the variables on the plane formed by the first two components. One deduction that may be readily drawn from this graph is the lack of any relationship between – on the one hand - the dose of (organic and inorganic) fertiliser nitrogen according to the survey data, and the irrigation rate and yields on the other. The latter two variables, on the contrary, are closely interrelated.

These findings and the existence of two groups (shaded on the graph), clearly differentiated with the cluster analysis³, led to an initial division of the holdings into two groups (T1 and T2), characterised by their yields and irrigation rates. The mean values for the two groups were as follows: group T1: 12,137 kg / ha and 1,409 m³/ha; and group T2: 8,231 kg / ha and 916 m³/ha, respectively.

³ In the clustering process the holdings were characterised by their principal components. The measure of holding proximity used was the euclidean distance and Ward's strategy was the aggregation method applied.

Figure 1:
 REPRESENTATION OF 28 HOLDINGS AND THEIR CHARACTERISTIC VARIABLES ("AIREN" VARIETY YIELDS, IRRIGATION RATE PER HA AND UNITS OF NITROGEN IN ORGANIC AND INORGANIC FERTILISER PER HA) ON THE FIRST FACTORIAL PLANE (Explained variance: 59%)



The final typology was formulated by dividing the holdings in each group into two classes, one consisting of holdings whose water consumption qualified them for the 1998 Wetlands Plan, i.e., the plan in place in the base year, and the other of holdings that were not eligible for the plan.

The typology used, then, was as follows:

T1A: Holdings irrigating vineyards at a normal rate (1,409 m³/ha) and adhering to the 1998 Wetlands Plan.

T2A: Holdings irrigating vineyards at a reduced rate (916 m³/ha) and adhering to the 1998 Wetlands Plan.

T1NA: Holdings irrigating vineyards at a normal rate and not eligible for the 1998 Wetlands Plan.

T2NA: Holdings irrigating vineyards at a reduced rate and not eligible for 1998 Wetlands Plan.

The total area and crop distribution in each of the four types of holdings are shown in Table 3.

TABLE 3 : Total area and crop distribution for the base year in the four farm types

	T1A	T2A	T1NA	T2NA
Total area (ha)	33.01	31.89	41.01	73.26
Non-irrigated land (ha)				
Olive tree	0.60	–	–	–
Barley	0.90	–	–	9.00
Oat	–	3.00	–	–
Fallow	0.34	1.16	–	1.98
Irrigated land (ha)				
Cencibel vineyard	0.55		1.77	0.75
Airén vineyard	11.34	10.85	12.68	34.43
Beet	1.80	0.80	3	2.90
Potato	–	–	0.45	2.50
Onion	–	–	–	2.5
Pea	1.06	–	–	–
Wheat	1.06	–	15.29	–

Barley	9.89	12.86	5.51	13.18
Maize	2.00	–	–	3.25
Fallow	3.47	3.22	2.31	2.77
Water consumption per ha eligible for aid (m ³ /ha)	1,896	991.7	2,852	3,631..20

T1A: Holding irrigating at a normal rate and adhering to the Wetlands Plan.

T2A: Holding irrigating at a reduced rate and adhering to the Wetlands Plan.

T1NA: Holding irrigating at a normal rate and not adhering to the Wetlands Plan.

T2NA: Holding irrigating at a reduced rate and not adhering to the Wetlands Plan.

With the exception of the yields and irrigation rates for the "airen" variety, the technical and economic coefficients for the crops were assumed to be the same in all four farm types. These coefficients were estimated, primarily from the survey data.

4. The model

The activities included in the model were essentially the set I of non-irrigated and irrigated crops, and the set J of the CAS formulas applicable to the holdings. The target function for the model is:

max:

$$\sum_{i \in I} (rs_i - \alpha_i CS_i + as_i) CS_i + \sum_{i \in I} (rs_i + as_i) CRS_i + \sum_{i \in I} (rr_i + ar_i) CRR_i - \sum_{i \in I} \beta_i CR_i^2 + \sum_{j \in J} \sum_{k \in K} ah_{jk} AH_{jk}$$

where:

CS_i = Area of non-irrigated crop i, in ha

CR_i = Initial area of irrigated crop i, in ha

CRS_i = Part of the area of CR_i converted to non-irrigated land

CRR_i = Part of the area of CR_i kept in irrigation

AH_{jk} = Area in ha to which Wetlands Plan formula j in area interval k is applied; k=1 corresponds to the first 40 ha; k=2 to area of over 40 ha and up to 80 ha; and k=3 to the remaining area in ha to which the Wetlands Plan is applied.

rs_i = Income per ha (excluding aid) for non-irrigated crop i

rr_i = Income per ha (excluding aid) for irrigated crop i

$as_i =$ CAP aid per ha of non-irrigated crop i

$ar_i =$ CAP aid per ha of irrigated crop i

$ah_{jk} =$ Aid per hectare under Wetlands Plan formula j in area interval k

$\alpha_i, \beta_i =$ Coefficients estimated by positive mathematical programming to calibrate the model to the base year.

Maximisation of this function is, moreover, subject to the following constrains:

$$\begin{aligned}
 \sum_i CR_i & \leq arr \\
 -CR_i + CRS_i + CRR_i & \leq 0 \\
 \sum_i CRS_i - ARS & = 0 \\
 \sum_i CS_i + \sum_i CRS_i - ARS & \leq ars \\
 \sum_i CRR_i + ARS & \leq arr \\
 \sum_k AH_{jk} - l_j \sum_i CRR_i - (1-l_j) \sum_i CRS_i & \leq 0 \\
 AH_{j1} & \leq 40 \\
 AH_{j1} + AH_{j2} & \leq 80 \\
 \sum_j H_j & \leq 1 \\
 -mH_j + \sum_k AH_{jk} & \leq 0 \\
 W - \sum_i w_i CRR_i & \leq 0 \\
 W + \sum_j mH_j - \sum_{j \in J} \sum_{k \in K} q_j AH_{jk} & \leq m \\
 CR_i, CRS_i, CRR_i, ARS_i, AH_{kj} & \geq 0 \\
 H_j : \text{Binary variables (0 ó 1)} &
 \end{aligned}$$

where, in addition to the definitions of the notations specified above:

$ARS =$ Area converted from irrigated to non-irrigated land, in ha

$W =$ Water in m^3 used for irrigated crops as a whole

$H_j =$ Binary variable (0 or 1) associated with Wetlands Plan formula j (the value is 1 if the holding applies formula j and 0 otherwise).

$arr =$ Area in ha of irrigated land on the holding

$ars =$ Area in ha of non-irrigated land on the holding

$l_j =$ 0 if $j = 1$ (100% reduction formula)
1 if $j \neq 1$

$m =$ Sufficiently large magnitude

$w_i =$ Volume, in m^3 per ha, needed to irrigate crop i

$q_j =$ Standard maximum allowable volume of water per ha adhering to Wetlands Plan formula j

It should be noted that the non-irrigated fallow land is included in CRS_i and CS_i and the irrigated fallow land in CRR_i . These fallow lands include both the compulsory set-aside for eligibility for COP crop compensatory payments, as well as any voluntary set-aside. Moreover, these set aside areas are expressed in relation to the total area devoted to COP crops. This relationship is also considered in the model, although it was not mentioned in the foregoing to simplify the description⁴.

Finally we will notice that the procedure to estimate the coefficients α_i and β_i to calibrate the model is fundamentally the same that the one described in Júdez et al. (2001).

5. Results

Table 4 summarises the results obtained for each farm type; detailed results can be found in Annexes 1 through 4. The most relevant features of these results are discussed below.

Farm types adhering to the Wetlands Plan in the base year

These are the T1A holdings adhering to a 50% reduction under the 1998 Wetlands Plan and the T2A holdings adhering to a 70% reduction.

⁴ See Judez et al. (1996) for a discussion of the way these restrictions are built into the model.

Farm type T1A

With the activities conducted on this holding in the base year, the volume of water used per ha eligible for 1998 aid is 1,896 m³ (the maximum allowable to qualify for aid for a 50% reduction is 2,100 m³/ha). This volume would be 1,930m³/ha under the 2003 Plan, which provides for a maximum of 773 m³/ha to be eligible for aid.

In other words, to qualify for the Wetlands Plan in the simulated year (2003 Plan), the holding must cut back its water consumption by at least 60%. The losses that would be incurred for this reduction are greater than would have to be accommodated if Wetlands Plan aid is forgone. The latter option, in any event, entails a decrease in the gross margin on the order of 10% in any of the scenarios for COP crop aid, since the Wetlands Plan aid accounts for approximately that percentage of the gross margin in the base year.

TABLE 4: Essential characteristics of holdings in the base year and variations in each of the simulated scenarios

	T1A	T2A	T1NA	T2NA
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Base year: CAP Agenda 2000				
1998 Wetlands Plan				
Total area (ha)	33.01	31.89	41.01	73.26
Irrigated vineyard area (ha)	31.18	27.73	41.01	62.28
Water used (1,000 m ³)	53.5	26.68	96.65	131.19
Wetlands Plan formula	50% reduc.	70% reduc.	None	None
CAP aid (€1000)	5.34	4.99	6.90	7.08
Wetlands Plan formula (€1000)	3.46	5.01	–	–
Total aid (€1000)	8.80	9.99	6.90	7.08
Gross margin (€1000)	31.98	19.69	42.87	56.26
Share of aid in gross margin (%)	28%	51%	16%	13%
Simulated year: 2003				
Wetlands Plan				
<u>2003 Wetlands Plan</u>				
<u>Arrangement</u>				
Agenda 2000	None	100% reduc.	None	None
MTR. Partial decoup.	None	100% reduc.	None	None
MTR. Total decoup.	None	100% reduc.	None	None
<u>Significant crop change</u>				
Agenda 2000	–	t.n.i.	–	–
MTR. Partial decoup.	0.2 ha uc	t.s. & 0.7 ha uc	–	–
MTR. Total decoup.	1.9 ha uc	t.s. & 1 ha uc	–	1.3 ha uc
<u>Variation in water use</u>				
Agenda 2000	0.0%	uc	0.0%	0.0%
MTR. Partial decoup.	+ 0.2%	–	- 0.6%	+ 1.1%
MTR. Total decoup.	- 3.4%	- 100.0%	- 0.8%	- 0.1%
<u>Variation in aid</u>				
Agenda 2000	- 39.3%	- 100.0%	0.0%	0%
MTR. Partial decoup.	-39.4%	+ 71.7%	- 1.7%	- 1.9%
MTR. Total decoup.	- 39.3%	+ 89.5%	- 1.4%	- 1.5%
<u>Variation in gross margin</u>				
Agenda 2000	- 10.8%	+ 93.7%	0.0%	0.0%
MTR. Partial decoup.	- 9.4%	–	+0.41%	+ 1.45%
MTR. Total decoup.	- 10.8%	+ 16.6%	+0.52%	+ 0.79%
<u>Share of aid in gross margin (%)</u>				
Agenda 2000	19.0%	+ 28.4%	16.0%	13.0%
MTR. Partial decoup.	18.0%	75%	16.0%	12.0%
MTR. Total decoup.	19.0%	76%	16.0%	12.0%
		77%		

uc. = uncultivated

t.n.i. = transformed from irrigated to non-irrigated

Forgoing the Wetlands Plan under the conditions imposed in 2003 does, however, not mean an increase in the water consumed compared to the base year, and in fact consumption actually decreases by 3% under the total decoupling scenario as a result of a reduction of nearly 2 hectares in the amount of cultivated land owing to the decline in prices for COP crops occasioned by decoupling. Finally, it should be noted the loss of Wetlands Plan aid in this holding in the simulated year brings the share of aid in the total margin down substantially, from 28% to around 18%-19%.

Farm type T2A

The amount of water per hectare eligible for Wetlands Plan aid in the base year (991.7 m³) qualifies this holding for compensatory allowances for reducing irrigation by 70%. Taking the eligible area in the 2003 Wetlands Plan, which would be in place in the simulated year as the basis for calculation, the amount of water consumed is 1088.5 m³/ha, which is higher than the 751 m³/ha allowed to be eligible for the plan.

The most profitable strategy for this farm type is to refrain from irrigation. The conversion from irrigated to dry crops entails a drop in gross margin (excluding the COP crop aid and the Wetlands Plan allowance), under any of the simulated scenarios, of around 40%. If, moreover, Agenda 2000 is the simulated scenario for COP crops, the compensatory payments for these crops decline by nearly 45% when non-irrigated instead of irrigated crop aid is received. Naturally, no such decline is observed when the scenario considered is the total decoupling formula under MTR arrangements, and the figure dips by only 8% in the event of partial decoupling. The losses described in the simulated scenarios are amply compensated by the rise in aid for reducing irrigation, which nearly trebles. This occasions an increase in the gross margin (including the CAP aid for COP and Wetlands Plan aid in revenues), ranging from nearly 17% in the Agenda 2000 scenario to more than 28% in the total decoupling scenario.

The share of aid in the total gross margin moves from about 50% in the base year to 75% or greater under the various simulated scenarios.

Farm types not participating in the Wetlands Plan in the base year

These holdings are T1NA, which consumes 2,852 m³ per hectare in the areas liable to receiving 1998 Wetlands Plan aid (base year scenario) and T2NA, which consumes 3,631 m³/ha in such areas. These figures are, obviously, higher than the 2,100 m³/ha maximum allowable to qualify for aid.

The amount of water consumed, taking the hectares liable to receive 2003 Plan aids⁵ as the basis for calculation, is higher than the ceiling for receiving aid in both types of holdings (the limit is 799 m³/ha in T1NA and 695m³/ha in T2NA).

In order to participate in the 2003 Wetlands Plan, T1NA and T2NA would have to reduce their water use considerably, with the concomitant losses in yield. The decrease in income caused by such losses is not offset by Wetlands Plan aid, and the strategy for these holdings, in all the simulated scenarios, is to continue to refrain from adhering to the plan.

The outcome of applying this strategy is that neither crop distribution nor the results for these holdings vary from the base year to the simulated year under CAP Agenda 2000 arrangements.

The minor variations observed between the base year and the simulated year when the decoupling of COP crop compensatory payments are in effect have to do with the specific aspects of the change in CAP policy that lead the farmers, in case of decoupling, to make their production decisions from a perspective of a decrease in COP prices (with greater drops under total than partial decoupling). As a result, COP crops are replaced by non-COP crops (although such replacements never affect vineyards) and some cultivated land may be set aside (as observed in the T2NA holding under decoupling arrangements). These actions improve holding performance, however, as they enable farmers to plan their production based exclusively on market prices (without the bias introduced in the COP crops by the respective compensatory payments) without

⁵ 2,497 m³/ha in T1NA, and 2,205 m³/ha in T2NA.

forfeiting compensatory aid (the decrease that modulation may entail has virtually no effect on these holdings).⁶

6. Conclusions

The present paper studies the effects on income and crop distribution of the implementation of the new Wetlands Plan policy approved in 2003 for four farm types. Such policy is regarded to be an accompanying measure to the current CAP measures (Agenda 2000) for COP crops or to the decoupled aid measures for these crops envisaged in the CAP MTR proposal put forward in September 2003.

The four farm types used, based on a survey of 51 holdings with irrigated vineyards, were defined in two stages. First the holdings were separated into two groups: one with a normal and the other with a reduced irrigation rate. This separation was designed to ascertain whether the amount of water used for this crop would influence adherence or otherwise of the various holdings to the 2003 Wetlands Plan, in which the area devoted to wine grape growing is eligible for aid for the first time. The second step in defining the farm types was to divide each of the first two groups into holdings adhering and not adhering to the 1998 Wetlands Plan, in effect in the base year.

The conclusions that can be drawn for these farm types in the various agricultural policy scenarios simulated are as follows:

1. Irrespective of vineyard irrigation rates, it is not in the interest of the holdings not adhering to the 1998 Wetlands Plan to adhere to the 2003 Plan.
2. Both the irrigation rate used for vineyards and the 1998 Wetlands Plan formula in place for holdings in the base year affect the decision to adhere to the 2003 Plan. In this study, farm type T1A, adhering to the 50% water reduction in the base year and using a normal irrigation rate (1,409 m³/ha), withdraws from the

⁶ In the decoupling scenarios, the gross margin for both holdings rises slightly with respect to the base year. In particular, in the T2NA holding, the increase in gross margin is higher under partial than under total decoupling, which is the opposite from what would be expected, since partial decoupling entails smaller compensatory payments and lower gross margins (excluding compensatory payments). The rationale for this finding is that an additional 1.3 ha are set aside under total decoupling arrangements.

Wetlands Plan when it means meeting the requirements contained in the 2003 Plan. Farm type T2A, on the contrary, whose vineyards are grown with a reduced amount of water (916 m³/ha) and which adheres to the 70% reduction arrangements in the base year, opts for a 100% reduction in irrigation under the terms of the 2003 Plan.

3. The measures of decoupling COP crop aid envisaged in CAP-MTR encourage more than those of Agenda 2000 for farmers to adopt a 100% reduction irrigation under CAS. That is because Agenda 2000 couple aid to the area used to grow COP crops, which is greater in the case of irrigated than non-irrigated land. Under partial decoupling, on the contrary, the relationship between aid received and existing crops is substantially attenuated. And this relationship disappears altogether under total decoupling arrangements, thereby obviating a decline in aid when irrigated land is converted to non-irrigated land. Despite this, in the holdings studied, the decision to adhere or otherwise to the new 2003 Wetlands Plan is unrelated to the CAP policy envisaged for COP crops. In fact, it is in the best interest of one of the farm types (T2A) to adhere to a 100% reduction in irrigation in the simulation year under all COP crop aid arrangements, whereas none of the other holdings would adhere to the Wetlands Plan under any of the arrangements.
4. It should be stressed that for all irrigated crops (except vineyards), the only two alternatives were an irrigation rate equivalent to the average rate presently used or conversion to non-irrigated crops. The model might be flexibilised by considering different circumstances for a given irrigated crop with various irrigation rates and yield levels. Such flexibility can be readily built into in the model if the necessary information is available⁷. Irrespective of this possible improvement, this paper illustrates the results that can be expected of the model proposed and shows that, from the methodological standpoint, it is a useful tool for analysing the possible effects of new allowance policies to compensate for reductions in irrigation in the context of the CAP Mid-term Review.

⁷ It would suffice to break down the CRR_i variables in the model discussed in section 4 into a summation of variables $\sum_k CRR_{ki}$, where CRR_{ki} would be the hectares of irrigated land used to produce crop i with irrigation rate k .

Annex 1: Crop distribution and economic results of different scenarios in farm type T1A (normal irrigation rate in vineyards and adhering to the Wetlands Plan in the base year)

	Base 2002	2003 Wetlands Plan					
	1998 Wetlands Plan & Agenda 2000	Agenda 2000	Var%	Partial decoupling	Var%	Total decoupling	Var%
Non-irrigated land (ha)							
Olive tree	0.60	0.60	0.00	0.60	0.00	0.60	0.00
Barley	0.90	0.90	0.00	0.72	-20.00	0.64	-28.89
Oats							
Compulsory set-aside	0.22	0.22	0.00	0.22	0.00	0.22	0.00
Voluntary set-aside	0.12	0.12	0.00	0.12	0.00	0.12	0.00
Irrigated land (ha)							
Cencibel vineyard	0.55	0.55	0.00	0.55	0.00	0.55	0.00
Arien vineyard	11.34	11.34	0.00	11.34	0.00	11.34	0.00
Sugar beet	1.80	1.80	0.00	1.90	5.56	1.91	6.11
Mid-season potato							
Onion							
Pea	1.06	1.06	0.00	0.97	-8.49	0.63	-40.57
Wheat	1.06	1.06	0.00	1.07	0.94	0.92	-13.21
Barley	9.89	9.89	0.00	9.97	0.81	8.90	-10.01
Maize	2.00	2.00	0.00	1.90	-5.00	1.80	-10.00
Compulsory set-aside	1.75	1.75	0.00	1.75	0.00	1.75	0.00
Voluntary set-aside	1.72	1.72	0.00	1.72	0.00	1.72	0.00
Total non-irrigated land with crops	1.50	1.50	0.00	1.32	-12.00	1.24	-17.33
Total irrigated land with crops	27.71	27.71	0.00	27.71	0.00	26.05	-5.99
Total non-irrigated land	1.84	1.84	0.00	1.66	-9.78	1.58	-14.13
Total irrigated land	31.18	31.18	0.00	31.18	0.00	29.52	-5.32
Wetlands Plan (WP) water reduction arrangements							
50%	1	0		0		0	
70%	0	0		0		0	
100%	0	0		0		0	
None	0	1		1		1	
Total water consumption (1,000 m ³)	53.50	53.50	0.00	53.58	0.15	51.71	-3.35
Water for WP eligible area (1,000 m ³)	36.58	53.50	55.52	53.58	46.47	51.71	41.36
Wetlands Plan area (1) (ha)	19.29	27.71	43.65	27.71	43.65	26.05	35.04
Total WP water/WP	1.90	1.93	1.62	1.93	1.77	1.99	4.48

area							
GM (2), without payments (1,000 €)	23.18	23.18	0.00	23.67	2.11	23.20	0.09
C. payments coupled herbaceous (1,000 €)	5.34	5.34	0.00	1.07	-79.96	0.00	-100.00
C. payments decoupled herbaceous (000 €)	0.00	0.00		4.26		5.34	
Wetlands Plan c. payments (1,000 €)	3.46	0.00	-100.00	0.00		0.00	-100.00
Total c. payments (1,000 €)	8.80	5.34	-39.32	5.33	-39.43	5.34	-39.32
Modulation cut-back (1,000 €)	0.00	0.00		0.02		0.02	
Total payments after modulation (1,000 €)	8.80	5.34	-39.32	5.31	-39.62	5.32	-39.51
GM after modulation (1,000 €)	31.98	28.52	-10.82	28.98	-9.37	28.52	-10.81
% Payments / GM.	27.52%	18.72%		18.33%		18.66%	
Quadratic GM without payments (1,000 €)	19.20	19.20	0.00	19.64	2.29	19.70	2.60
Quadratic GM with payments (1,000 €)	28.00	24.54	-12.36	24.95	-10.88	25.02	-10.63

(1): Water consuming area eligible for Wetlands Plan arrangements.

(2): GM: Gross margin.

Source: model results.

Annex 2: Crop distribution and economic results of different scenarios in farm type T2A (reduced irrigation rate in vineyards and adhering to the Wetlands Plan in the base year)

	Base 2002	2003 Wetlands Plan					
	1998 Wetlands Plan & Agenda 2000	Agenda 2000	Var%	Partial decoupling	Var%	Total decoupling	Var%
Non-irrigated land (ha)							
Olive tree							
Barley							
Oats	3.00	0.38	-87.33	2.34	-32.00	2.04	-32.00
Compulsory set-aside	0.75	3.79	405.33	0.75	0.00	0.75	0.00
Voluntary set-aside	0.41	0.00	-100.00	0.41	0.00	0.41	0.00
Irrigated land (ha)							
Cencibel vineyard							
Arien vineyard	10.85	(10.85)	-100.00	(10.85)	-100.00	(10.85)	-100.00
Sugar beet	0.80		-100.00	0.00	-100.00	0.00	-100.00
Mid-season potato							
Onion							
Pea							
Wheat							
Barley	12.86	(16.88)	-100.00	(13.66)	-100.00	(13.66)	-100.00
Maize							
Compulsory set-aside	1.61	0.00	-100.00	1.61	0.00	1.61	0.00
Voluntary set-aside	1.61	0.00	-100.00	1.61	0.00	1.61	0.00
Total non-irrigated land with crops	3.00	28.11	837.00	26.86	785.00	26.55	785.00
Total irrigated land with crops	24.51	0.00	-100.00	0.00	-100.00	0.00	-100.00
Total non-irrigated land	4.16	31.90	666.83	28.02	566.11	27.71	566.11
Total irrigated land	27.73	0.00	-100.00	3.22 **	-88.39	3.22 **	-88.39
Wetlands Plan (WP) water reduction arrangements							
50%	0	0		0		0	
70%	1	0		0		0	
100%	0	1		1		1	
None	0	0		0		0	
Total water consumption (1,000 m ³)	26.68	0.00	-100.00	0.00	-100.00	0.00	-100.00
Water for WP eligible area (1,000 m ³)	16.74	0.00	-100.00	0.00	-100.00	0.00	-100.00