

THE CAP ACCOMPANYING MEASURES FOR THE ENVIRONMENTAL PROTECTION AND THEIR EFFECTS IN AN ITALIAN AGRICULTURAL AREA (*)

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The protection of environment and rural land conservation are in fact today, immovable reference points in the agricultural and environmental policy of the European Union, even in the case of specialized agricultural systems.

Recently the EEC policy for the environment has produced several regulations, of which 2328/91 and 2092/91, 2078/92 and 2080/92 —the last two de-

defined as accompanying measures in the more general Reform of the CAP in 1992 —must be mentioned for the importance of their contents.

In particular, the Regulation 2078/92 summarizes all the provisions carried out by the EEC for the protection of

ABSTRACT

This paper intends to evaluate the prospects of the EEC Regulations 2078/92 and 2080/92 application which have fixed specific rule about environmental protection. The present agricultural system of the "Lago Arancio" district, in the south-west of Sicily (an Italian region), has been analyzed and compared with two scenarios where different land managements are supposed to be carried out.

These scenarios have been studied by means of a multicriteria analysis method to take into consideration simultaneously both the economic and the environmental aspects for each alternative scenario.

From the analysis it emerges that the third scenario is preferred to the others: therefore it seems that the cultivation of a part of the district through organic farming (Regulation 2078/92) and afforestation (Regulation 2080/92) would allow to get a higher environmental protection in the rural areas.

RÉSUMÉ

Cet étude se préfixe d'évaluer les effets produits par l'application des règlements de la C.E.E. 2078/92 et 2080/92 qui définissent des dispositions en matière de protection environnementale. L'actuel système agraire -Lago Arancio-, au sud-ouest de la Sicile (une région italienne), est analysé et comparé avec deux scénarios où on a supposé des différents aménagements agricoles.

Ces scénarios sont étudiés par une méthode d'analyse multicritère, de façon que pour chacun d'eux, on a considéré les aspects économiques ainsi que les environnementaux.

Des résultats observés on déduit que le troisième scénario est préféré aux autres: pourtant il semble que la culture biologique (Rég. 2078/92) et le reboisement (Rég. 2080/92), réalisés sur une partie du territoire, puissent garantir un plus haut niveau de protection environnementale.

the environment, as to agriculture: extensive farming, set-aside, production systems with low or no environmental impact.

The Regional government of Sicily has applied EEC Regulations 2078/92 and 2080/92 by means of regional decrees and has also drawn up a specific plan of financial interventions.

The aim of the research, carried out over the last three years by a team of researchers of E.I.T.A. Department, is to evaluate the impact of the EEC agricultural and environmental policies and regional programs on rural land and, particularly, on the "Lago Arancio" district, an intensively cultivated agricultural area in western Sicily.

THE CAP ENVIRONMENT-RELATED ACCOMPANYING MEASURES AND THEIR APPLICATION IN SICILY

a) Implementation of EEC Regulation 2078/92 in Sicily

The EEC Regulation 2078/92 (acknowledged by Sicily with the regional plan, December 1994) seems to be the most innovative of the CAP accompanying measures, aiming at the environmental protection and the care of the natural space through not only the adoption of other production methods and techniques (with low environmental impact) but also, as to certain crops, to reach an equilibrium of markets and to provide a satisfactory income aid to the farmers.

The positive effects from the application of the Regulation concern, on one hand, the safeguard of the whole agro-ecosystem (air, waters, soil, fauna, flora, etc.) and on the other hand, an integration of income for those farmers who manage the farm by paying attention to the environmental preservation, supporting them with

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The paper is the result of a collaborative study conducted by the authors. Nevertheless, Antonio Asciuto is responsible for the sections related to the methodological aspects of the multicriteria analysis, the results and their discussion, Teresa Cirivello has drawn up the section concerning the evaluation of the economic indicators in the different scenarios and Maria Crescimanno has written about the application of EEC Regulations 2078/92 and 2080/92 in Sicily. The foreword and the conclusions have been drawn up by the authors altogether.

financial incentives.

In the case study of the "Lago Arancio" district, an increase in the Agricultural Added Value of the crops carried out with organic farming (mainly thanks to the subsidies) and a higher overall labour requirement —due to an expansion of it in most of the crops—are to be pointed out.

The scenarios assumed in this study, where part of the current agricultural land (carried out with intensive farming) is supposed to turn into organic farming, fall perfectly within the environment-related EU policies and can be associated with the guidelines of the Regulation 2092/91.

It must be stressed that in Sicily, in 1996, on the basis of the statements by the Certification Bodies, the organic farming was carried out on 24,486 ha while the reconversion was practised in 65,539 ha.

As it can be noted in **table 1**, with reference to the same year (1996), the total land financed (in 1994, 1995 and 1996) concerning A1 (significant reduction of pesticides) and A2 (organic farming) actions amounts to 86,253 ha (58% of these are related to A2 action), while in 1997 it equals 108,347 ha (59% for A2 action again). The overall sum which has been financed up to 1997 is about 26.2 millions ECU as to A2 action and 18.9 millions ECU as to A1 action.

Currently, the total area accepted for contributions provided by the EEC Regulation 2078/92 amounts in Sicily to 157,714 ha, representing about 10% out of the regional Used Agricultural Land (UAL).

The application of these EU environment-related measures has been more or less successful, in Italian regions, in relation to the regional governments' capacity of adapting the precepts of such a Regulation to the regional land and to the various agricultural issues.

Sicily, according to the latest available national statistics (1996), is the 4th region as to land areas interested by EEC Regulation 2078/92 and the 1st in the south of Italy, showing a political adhesion to the Regulations which indicates a new way to evaluate relationships be-

tween agriculture and environment.

b) Implementation of EEC Regulation 2080/92 in Sicily

The effects of the actions related to the enforcement of the EEC Regulation 2078/92 are mainly represented by the direct reduction of the pollution produced by pesticides and artificial fertilizers and, indirectly, by a landscape quality improvement. On the other side, the afforestation of agricultural lands withdrawn from production, granted by the EEC Regulation 2080/92, besides the same positive impacts on soil, underground waters, running waters, atmosphere and public health, aims at the reintroduction of wild fauna and autochthonous flora and plays an important role in the renaturalization of areas spoilt by human activity, in soil conservation and, above all, as to landscape aspects.

In the analysis of the benefits from afforestation and restoration of deteriorated woods, the economic returns from principal and secondary wood products and the recreational use must be kept in mind.

The results gained by the Application Programme, firstly set up by Sicilian Region for the period 1994/96 and then extended to 1997, are very satisfactory in comparison with the previous forestry actions (Law 3267/23, the Green Plan, the Special Project no. 24 by the Development Fund for the South of Italy, the Organic Action no. 9 by the Agency for the Extraordinary Intervention in the South of Italy, the EEC Regulation 797/85 on the set-aside of arable lands, etc.) in terms of answers from private owners, especially in Southern regions of Italy.

Nevertheless, in Sicily a limited availability of EEC funds has not allowed to finance many projects, making necessary the application of priority criteria, as however stated in the Application Programme and also the use of the draw in the selection of the forestry projects.

In fact, the financial allotments for the 1994-97 period represent only 28% out of the initial Regional forecasts. As it can be noted from the evaluation of the benefits

Table 1 Application of EEC Regulation 2078/92 in Sicily over the period 1994-97 (monetary values are expressed in 000 ECU, where 1 ECU = 2,330 Italian Lire).

Years	A1 - Reduction of pesticides Financed applications			A2 - Organic farming Financed applications			Other actions Financed applications			Overall results Financed applications		
	Number of applications	Total land (ha)	Overall amount (000 ECU)	Number of applications	Total land (ha)	Overall amount (000 ECU)	Number of applications	Total land (ha)	Overall amount (000 ECU)	Number of applications	Total land (ha)	Overall amount (000 ECU)
1994				336	3,943.23	2,121				336	3,943.23	2,121
1995	4,991	24,309.65	10,581	1,997	22,673.3	10,536	3,837	15,637.26	6,601	10,825	62,620.21	27,718
1996	2,719	11,800.76	4,918	2,010	23,525.95	8,518	3,463	14,886.14	5,884	8,192	50,212.85	19,320
1997	2,036	8,051.49	3,405	1,165	14,042.84	5,033	4,206	18,843.51	7,106	7,407	40,937.84	15,544
Total	9,746	44,161.90	18,904	5,508	64,185.32	26,208	11,506	49,366.91	19,591	26,760	157,714.13	64,703

Source: Regional Board of Sicily for agriculture and forestry.

Table 2 Application of EEC Regulation 2080/92 in Sicily over the period 1994-97 (monetary values are here expressed in 000 ECU, where 1 ECU = 2,330 Italian Lire).

Years	Afforestations			Woodlands improvement								
	Submitted applications	Accepted applications	Accepted applications	Submitted applications	Accepted applications	Accepted applications						
	Number of applications	Land for afforestation (ha)	Overall amount (000 ECU)	Number of applications	Land for afforestation (ha)	Overall amount (000 ECU)	Number of applications	Land for improvement (ha)	Overall amount (000 ECU)	Number of applications	Land for improvement (ha)	Overall amount (000 ECU)
1994	634	9,610	34,858	159	2,023	5,626	247	2,274	4,827	28	900	1,160
1995	748	11,353	37,074	168	1,990	5,891	281	2,831	6,747	63	1,717	1,778
1996	509	7,672	28,534	278	3,172	10,502	264	2,621	4,178	70	1,652	2,310
1997	761	9,816	38,488	279	3,480	11,383	223	7,942	13,211	89	2,509	3,197
Total	2,652	38,451	138,955	884	10,665	33,401	1,015	15,668	28,962	250	6,778	8,445

Source: Regional Forest Farm

deriving from the application of EEC Regulation 2080/92 to the "Lago Arancio" district, the main action concerns the introduction of broad-leaved, either for fruit (e.g. walnut) and for wood arboriculture; in particular the lands where they are assumed to be planted are not only arable lands (whose productions are in excess in the EU) but also, in our case, marginal citrus orchards. So the assumed scenarios in the district allow the farmers to get both direct and indirect benefits (the latter in order to compensate the non-earned incomes on the basis of the land resources use before the conversion). **Table 2** reports, as to some actions, both the applications submitted and the applications accepted for funding (with the corresponding sum financed) in the period 1994/97: with regard to the actions concerning afforestations, the small number of the accepted projects (just 33% out of the submitted ones) and consequently the land for afforestation, equal to 10,600 hectares (out of 38,000 ha regarding the applications submitted), are to be pointed out in the analysis of the current situation. The overall sum with relation to the accepted applications is about 33.4 millions ECU, most of which occurs in the last two years of the period (65.5% of the total). In any case, the afforestation of agricultural lands, carried out mainly by using broad-leaved (80% of the total land for afforestation) has concerned, in the considered period, very low percentages of the regional Used Agricultural Land (UAL), just around 0.7%. As to the actions related to the improvement of the existing woodlands, the applications financed (only 24.6% out of the submitted ones) interest 6,778 hectares (43.2% of the total land for afforestation submitted) and an amount around 8.5 millions ECU. On average, the amount of the aid per hectare equals 1,245 ECU, while the woodlands for improvement represent 1.9% out of the regional forest area. On the basis of the first results the land-use distribution concerning afforestations is the following:

70% arable lands, 25% grasslands and the remaining 5% other crops. It follows that the main goal of this Regulation, that is the reduction of exceeding crops surfaces

(wheat, other grains, green-crops, etc.) has been achieved, at least partially.

The main difficulties for the land owners are to be sought in the supply of forestry nursery material and in the observance of the works timetable because of their seasonal character. Moreover most agricultural lands for the afforestation are located in hilly and mountainous areas with an irregular morphology; for this reason, time for the plantation is always strict (only from late summer to late autumn), needing an opportuneness which does not accord with the spaces of time fixed by the measures for the concession of the incentives.

Nevertheless the most urgent issue concerns the supply of the material for forestry nurseries with autochthonous seedlings to preserve biodiversity.

According to Regional Application Programme, responsibilities of decisions about the species to be used in the afforestations and reafforestations have been at the moment delegated to Forestry Planners and Works Directors, in expectation of the establishment of a regional seedling centre. The 1997/99 Programme for Sicily, which is supposed to become effective in the spring of 1998, although it keeps unchanged the previous guideline (plantations with fast-growing species to be used in the paper industry and species for the production of high quality wood for the industry of furniture), it pays much attention to the afforestation for the improvement and protection of rural land, providing also the possibility to plant species belonging to the high Mediterranean brushwood.

This policy line, aimed at the environmental restoration of hilly and mountainous lands, also inside protected areas, will be able to play a relevant role in the rural land for the positive effects determined by a massive adhesion of private and public owners to the regional programme.

THE EVALUATION OF THE ECONOMIC INDICATORS IN THE THREE CONSIDERED SCENARIOS

A wide district (152.2 km²) of southern-western Sicily (Italy) has been studied. Intensive farming is mainly

practised in this area, thanks to the presence of Lake Arancio whose waters are used for irrigation.

The present land-use has been studied by means of aerial photography and a map has been plotted using ARCH-INFO software.

A comprehensive analysis shows some social and economic aspects (Agricultural Added Value, employment in agriculture) and environmental factors, such as fauna, flora, hydrology, landscape.

Starting from the present situation (scenario 1), two more scenarios, forecasting land changes in the next 50 years on account of the enforcement of Regulations 2078/92 and 2080/92, were supposed (see **table 3**), in order to verify the influence of the EU environmental policy in the "Lago Arancio" district.

In the second scenario it is assumed that the organic production techniques are carried out on 20% of the present area grown to wheat, artichokes, vines, olives and citrus fruits, therefore receiving the financial contributions provided for 5 years by Sicilian Region. In the following 45 years organic farming is supposed to continue, in spite of the cessation of regional financial subsidies.

In the third scenario it is presumed that in addition to 20% of the area cultivated with organic techniques (see scenario 2), another part of the area, covered with citrus orchards (which at the moment represent marginal cultivations), vineyards and arable land, is afforested employing walnut trees, other broadleaf trees and conifers in accordance with Regulation 2080/92, considering that costs referred to this area are totally refunded by the subsidy fixed by the above Regulation.

The regional law which has acknowledged such a regulation, foresees diversified contributions according to the different species.

In accordance with this regional applied law, the fol-

lowing land use, in compliance with the bounds imposed by E.E.C. Regulation 2080/92, has been assumed: an area of 300 hectares planted with irrigated walnuts, 150 hectares with dried walnuts (action no.5) and 700 hectares with mixed afforestations of broadleaved and conifers (action no.4). With regard to the last ones (700 hectares), Aleppo Pine (*Pinus halepensis*) is supposed to be planted on the 30% of the total area, choosing land with the worst morphological and pedological nature; European Hackberry (*Celtis australis*) and Common Olive Tree (*Olea europaea*) are assumed to cover another 30% of the area (15% each species) while the remaining 40% is represented by Carob Tree (*Ceratonia siliqua*).

The regional law states that, apart from a subsidy (100%) for the planting costs and for the maintenance expenses (for the following 5 years), an indemnity covering the non-earned incomes has to be paid for 10 years.

Even in this scenario (the third one), besides a financial summation (at the 50th year) of Added Values regarding both the organic farming and the conventional one, the values of the wood trees and of Carob tree and Common Olive Tree are added and carried financially at the end of the 50th year.

From this summation an annual value is derived by means of a financial formula and then compared with the others (related to scenarios 1 and 2).

The present subsidies, provided for by the regional programmes after acknowledgement of EEC Regulations, are here supposed to go on only for five years as to Regulation 2078/92, and twenty years as to Regulation 2080/92. Therefore these hypotheses are in line with the E.U. agricultural policies meant to stop this kind of contributions in a medium-term period.

The comparison between the present scenario (sce-

Table 3 Cultivated area distribution in the "Lago Arancio" district.

Crops	Scenario 1		Scenario 2		Scenario 3	
	Conventional Agriculture Area hectares	Organic Farming Area hectares	Conventional Agriculture Area hectares	Organic Farming Area hectares	Conventional Agriculture Area hectares	Afforestation Area hectares
Arable lands	6,475	957	5,518	957	4,818	700
Wheat	3,565	713	2,852	713	2,152	700*
Follow land	645		645		645	
Fodder crops	645		645		645	
Vegetables	1,620	244	976	244	976	
Artichoke	1,220		400		400	
Other vegetables	400					
Tree cultivations	7,890	1,578	6,312	1,578	5,862	450
Citrus orchard	770	154	616	154	316	300**
Vertical trellis vineyard	5,155	1,031	4,124	1,031	3,974	150***
Overhead trellis vineyard	60	12	48	12	48	
Olive orchard	1,905	381	1,524	381	1,524	
Grasslands	250		250		250	
Total cultivated area	14,615	2,535	12,080	2,535	10,930	1,150

*: Broadleaved and conifers
 **: Irrigated walnuts
 ***: Dried walnuts

nario 1) and the assumed ones (scenarios 2 and 3) has been carried out through a series of environmental indicators, chosen through the joint-work by an equipe of experts.

As regards to the economic indicators, those calculated for each scenario are the Labour Requirement and the Added Value.

The agricultural Added Value of the district has been calculated applying some financial mathematics coefficients to the current value, in order to obtain an amount comparable in the three scenarios, taking into account the different temporality and duration of the contributions endowed by E.U.

The estimate of the economic indicators considered in the research (Added Value and Labour Requirements) has been carried out through a survey aimed at quantifying the crop yields and the farm requisites used in the main cultivations of the "Lago Arancio" district.

The Added Value—which represents the wealth produced during one year in a considered land, and therefore is a quite significant indicator to check the state of health of the economy in the agricultural sector.—has been obtained by calculating the Gross Saleable Production (GSP) and the Intermediate Inputs (II) for each crop practiced in the area.

GSP has been quantified by attributing average crop yields to the corresponding land use areas (Scenario 1, 2 and 3). The prices adopted for the outputs are quite prudential and refer to recent statistical figures.

As to the second scenario, GSP has been determined adopting the yields and market prices peculiar to the organic crops and then adding the amounts of the subsidies endowed by E.E.C. Regulation 2078/92 (A2 action in the regional law).

The methodology for the determination of GSP in the Scenario 3 has been differentiated according to the various forest trees included.

Starting with the walnut plantations, they have been subdivided into dried walnuts (with a 50 year forest rotation) and irrigated walnuts (a 40 year forest rotation). As to the first ones, the AV has been estimated only for the wood production assuming that the fruit production value only compensates the production costs. The stumpage value has been obtained from a study on walnut plantations in Sicily (Antonio Ascuto, 1992).

The subsidies for the maintenance expenses and the non-earned incomes have been summed up at the end of the rotation (50th year) at a 5% discount rate and then the corresponding annual amount has been obtained.

The intermediate inputs have been detracted from the overall GSP in order to get the Added Value.

The same procedure has been followed in the case of the irrigated walnuts and the stumpage value and the relative indemnity have been determined.

With regard to the wood trees (Aleppo Pine and Euro-

pean Hackberry), the Added Value has been calculated at the end of the forest rotation by means of available data on the average yearly growths and the stumpage prices of the obtainable sorters. These figures have been obtained from some research projects carried out previously by the researchers of our Department and from direct surveys on sicilian plantations.

Also the yields and prices concerning olives and carobs have been employed in the analysis on the basis of data from agricultural statistics and from direct farm surveys.

The annual GSP value has been obtained through the financial summation (at the end of the rotation) of the annual productions, starting from the 16th year for the Common Olive Tree plantations and from the 20th year for the Carob Tree plantations. As to the last tree crop, the subsidy paid by Sicilian Region (180 ECU/hectare) from the 21st year up to the 40th year for the non-earned incomes has been taken into account in the calculations.

The agricultural system of production in the present situation (scenario 1) and the new supposed scenarios in the "Lago Arancio" district, made it possible to determine for each cultivation the labour requirement expressed in working days and therefore the total labour requirement in the three scenarios.

The labour requirements have been estimated by paying attention to the annual working timetable for each crop of the district, built on the basis of specific farm surveys.

This indicator can be divided into manual work and machine work, whose values are in any case expressed in hours/hectare. At the end of the calculations, the overall labour requirements values in the different scenarios have been transformed into working days/year by considering 7 hours of work for each working day. The obtained results indicate that the scenario with the greatest requirement is the second with 379,817 working days, followed by scenario 1 with 378,195 days and, finally, by scenario 3 with 369,117 (see **figure 1**).

On the whole, results do not show great differences in the three scenarios; consequently the labour required for hectare is rather uniform.

As for the territorial Added Value, although with small differences (see **figure 2**), the highest level equal to 23.5 million ECU, has been achieved in scenario 1 (see **table 4**) where, as reported above, conventional agriculture is carried out with the prevailing use of synthetic chemical products; the lowest value is achieved in scenario 3, that is 22.4 million ECU (see **tables 5 and 6**).

METHODOLOGICAL ASPECTS OF THE RESEARCH: THE MULTICRITERIA ANALYSIS

The analysis has been carried out by using the II version of ELECTRE (ELimination Et Choix TRaduisant la REalitiè), which is a method belonging to the wide

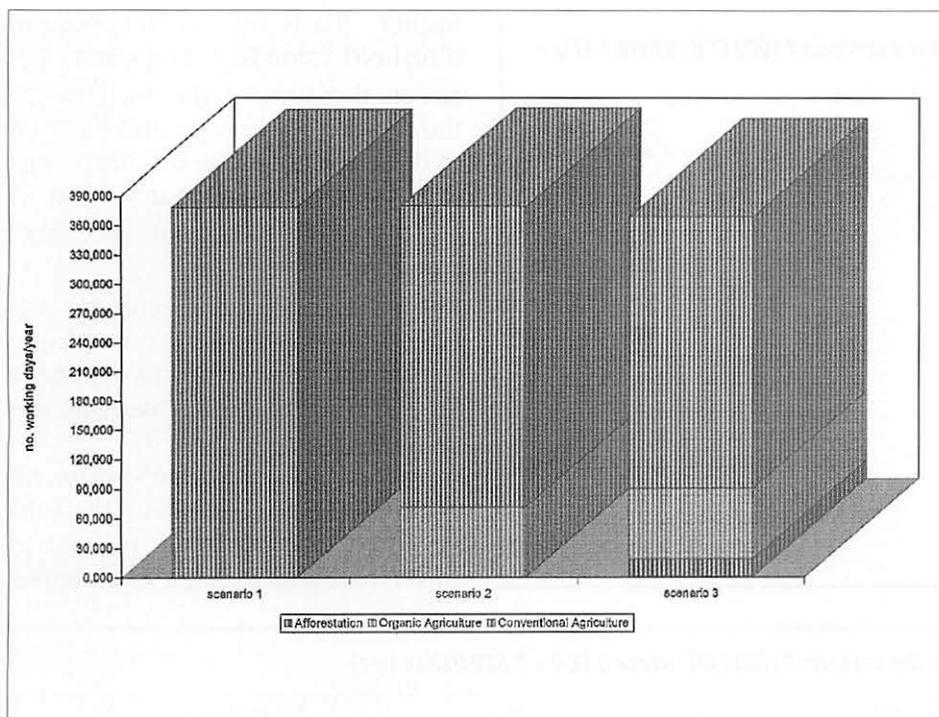


Figure 1 - Total labour requirements in the scenarios considered.

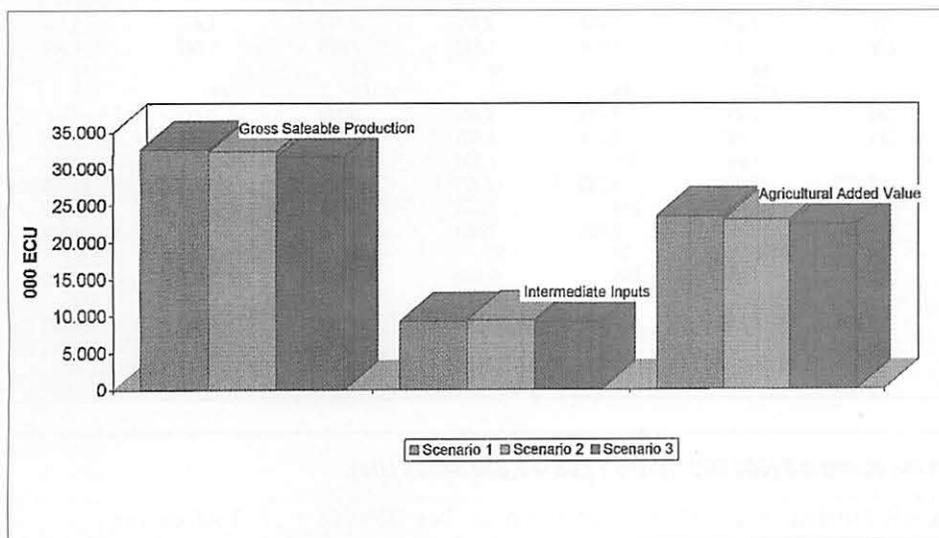


Figure 2 - Gross Saleable Production, Intermediate Inputs and Agricultural Added Value in the considered scenarios (1 ECU = 2,330 Italian Lire).

category of "outranking" or "concordance" techniques. They are based upon a systematic analysis of the relationship between all pairs (pair-wise comparisons) of a finite set of options, using information about the impact scores of each option on a set of criteria.

In order to determine the relative importance of the criteria, different weights are assigned to them, according to the contribution of each criterion to the overall environmental quality. This is a difficult step because it has to pay attention to preferences of society about the environment involved by the modification of the present

scenario.

Up to now the construction of a collective preference function for environment has proved to be quite complex, so the possible solutions are to entrust policy decision makers, various interest groups or experts with the weights assignment. In this specific study the adopted solution is the last one.

The procedure of ELECTRE method aims at measuring the dominance of one alternate action over another, with the view of identifying the option which outranks the others. The fundamental elements of this method are represented by the concordance and discordance indices.

The first one for a pair of alternate actions is defined as follows:

$C_{ii'}$ = Sum of the weights referred to the criteria for which "i" is rated equal to or better than i' divided by the sum of all the weights for the full set of criteria.

The discordance index, calculated using standardized data, is given by:

$D_{ii'}$ = Sum of the weighed differences between the values of i and i' for all the criteria for which i' is rated higher than i divided by the sum of the weighed differences for the full set of criteria.

The above definition for the discordance index adopted in this case represents only one among all the formulae to calculate it and the same consideration can be repeated for the concordance index.

Once the indices have been calculated for all pairs of alternative options, they are summarized reporting them in two different matrices, called Concordance and Discordance Matrix.

The next step is to order the options and this is possible, in ELECTRE II, comparing the indices with threshold values through which an outranking relationship between all pairs can be derived. In this version of ELECTRE two different threshold values are fixed for the discordance index and three for the concordance index.

This way it is possible to define two kinds of outranking: the weak one and the strong one.

For two options i and i', i outranks strongly i' when the following three conditions are satisfied: 1) $C_{ii'}$ must be

Table 4 Agricultural Added Value of the district in the scenario 1 (000 ECU, where 1 ECU = 2,330 Italian Lire).

Crops	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value
<i>Arable lands</i>	3,094	1,413	1,681
Wheat	2,891	1,345	1,546
Fallow land	34		34
Fodder crops	169	68	101
<i>Vegetables</i>	9,471	2,458	7,013
Artichoke	7,669	1,917	5,752
Other vegetables	1,802	541	1,261
<i>Tree cultivations</i>	20,101	5,316	14,785
Citrus orchard	3,227	645	2,582
Vertical trellis vineyard	12,962	3,500	9,462
Overhead trellis vineyard	170	48	122
Olive orchard	3,742	1,123	2,619
<i>Grasslands</i>	13	1	12
Total	32,679	9,188	23,491

Source: Our calculations.

higher than the corresponding threshold value (c_s), 2) the ratio between the sum of the weights for the concordant criteria and the sum of the weights for the discordant criteria must be more than 1, and 3) D_{ii} must be lower than the corresponding d_s .

The same operations must be followed to check weak outranking, that is comparing the two indices for each pair of alternatives with the weak threshold values.

If at the end of this procedure no option is able to dominate the others, then thresholds are relaxed in order to eliminate the dominated

Table 5 Agricultural Added Value of the district in the scenario 2 (000 ECU, where 1 ECU = 2,330 Italian Lire).

Crops	Organic farming - Reg. 2078/92			Conventional agriculture			Total district		
	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value
<i>Arable lands</i>	593	271	322	2,519	1,144	1,375	3,112	1,415	1,697
Wheat	593	271	322	2,316	1,076	1,240	2,909	1,347	1,562
Fallow land				34		34	34		34
Fodder crops				169	68	101	169	68	101
<i>Vegetables</i>	1,423	639	784	7,937	2,075	5,862	9,360	2,714	6,646
Artichoke	1,423	639	784	6,135	1,534	4,601	7,558	2,173	5,385
Other vegetables				1,802	541	1,261	1,802	541	1,261
<i>Tree cultivations</i>	3,824	1,199	2,625	16,080	4,260	11,820	19,904	5,252	14,652
Citrus orchard	709	137	572	2,581	516	2,065	3,291	658	2,633
Vertical trellis vineyard	2,490	783	1,707	10,369	2,808	7,561	12,860	3,472	9,388
Overhead trellis vineyard	34	10	24	136	38	98	169	47	122
Olive orchard	591	269	322	2,994	898	2,096	3,584	1,075	2,509
<i>Grasslands</i>				13	1	12	13	1	12
Total	5,840	2,109	3,731	26,549	7,480	19,069	32,389	9,382	23,007

Source: Our calculations.

Table 6 Agricultural Added Value of the district in the scenario 3 (000 ECU, where 1 ECU = 2,330 Italian Lire).

Crops	Conventional Agriculture			Organic Farming - Reg. 2078/92			Afforestation - Reg. 2080/92			Total district			
	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value	Crops	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value	Gross Saleable Production	Intermediate Inputs	Agricultural Added Value
<i>Arable lands</i>	1,950	880	1,070	593	271	322	<i>Total woods</i>	462	46	416	3,005	1,197	1,808
Wheat	1,747	812	935	593	271	322	<i>Broadleaved and conifers</i>	462	46	416	2,802	1,129	1,673
Fallow land	34		34							34			34
Fodder crops	169	68	101							169	68	101	
<i>Vegetables</i>	7,937	2,075	5,862	1,423	639	784				9,360	2,714	6,646	
Artichoke	6,135	1,534	4,601	1,423	639	784				7,558	2,173	5,385	
Other vegetables	1,802	541	1,261							1,802	541	1,261	
<i>Tree cultivations</i>	14,446	3,907	10,539	3,824	1,199	2,625	<i>Total walnuts</i>	895	124	771	19,165	5,230	13,935
Citrus orchard	1,324	265	1,059	709	137	572	<i>Irrigated walnuts</i>	691	104	587	2,725	506	2,220
Vertical trellis vineyard	9,992	2,706	7,286	2,490	783	1,707	<i>Dried walnuts</i>	204	20	184	12,687	3,509	9,177
Overhead trellis vineyard	136	38	98	34	10	24				169	48	121	
Olive orchard	2,994	898	2,096	591	269	322				3,584	1,167	2,417	
<i>Grasslands</i>	13	1	12							13	1	12	
Total	24,346	6,862	17,484	5,840	2,109	3,731	Total	1,357	170	1,187	31,543	9,142	22,401

options and finally the ordering is completed. Another methodology to order the different alternatives is based upon the overall (or absolute) concordance and discordance indices, calculated for each option by subtracting the sum of the column elements from the sum of those placed in the corresponding row of concordance and discordance matrices.

Therefore the options are rated according to the values of the above indices in the following way: as to the absolute concordance index, the order is from the greater value to the smaller one, while for the discordance index is exactly opposite. The purpose of this index is to measure the general dissatisfaction of the decision-maker for having chosen the considered alternative and therefore, the lower its value, the more attractive the option. On the contrary, the concordance index represents the way the option at issue is better than the others and consequently the higher the score, the more satisfactory the solution.

RESULTS AND DISCUSSION

In this section the main steps of the analysis and the results gained will be reported briefly, with some comments that aim at explaining and interpreting the order of the three scenarios resulted from the algorithm here carried out.

A set of 11 criteria was chosen in order to encompass the main factors interested by the modifications according to the scenarios described in the preceding sections. The values of the environmental indicators taken into account for the analysis (with the only exception represented by the social-economic aspects) derive from qualitative judgements given by experts, that have been turned into cardinal values by means of scales of transformation based on the theory of the fuzzy sets and particularly on Chen and Hwang's work (1992). On the ground of the principles of this approach, any verbal term can be represented by means of a function, which expresses the degree of belonging of "x" to the set described in the verbal judgement, and called "fuzzy number".

Once fuzzy numbers with different ranges have been assigned to each verbal term, they are transformed in cardinal numbers ranging between 0 and 1.

Chen and Hwang in their paper have built 8 scales (reported in **table 7**) which keep the same degree of uncertainty found sometimes in experts' evaluations and that can be chosen by the analyst in consequence of the set of terms used to describe the score of the criterion.

In order to carry out the above reported conversion, it has been made reference to the scales by Chen and Hwang, modifying the range of numbers from the original 0-1 into 0-100 (each number has been multiplied by 100).

Following this procedure, a decision matrix with 11 cardinal numbers (see **table 8**) has come up from a set of 9 criteria previously expressed in a qualitative way; but at this point the data were not standardized yet because two out of eleven criteria were originally quantitative, the first one expressed in working days (labour requirement) and the second in monetary unit (ECU). As a consequence of it, standardization has become necessary by means of a procedure which consists of dividing each raw score by the highest one of the same column.

Once the data were standardized, a team of experts have assigned the weights to the criteria following an iterative procedure, at the end of which each criterion was associated with a weight, whose total sum was equal to 1 (see **table 9**).

The next step has concerned the choice of the threshold values for the concordance and discordance indices: with regard to the former their values derive from environmental literature (C+ equal to 0.60, Co equal to 0.55 and finally C- to 0.50), while the discordance index thresholds used in this analysis are 0.20 and 0.40, very strict, in order to obtain a solid rating of the alternatives. From the calculation of the two indices for each pair of options, summarized in the corresponding matrices (see **tables 10-11-12**), it has come out that the alternative "Scenario 3" strongly outranks both the others, "Scenario 2" is outranked by S3 and finally "Scenario 1" is outranked in the pair-wise comparisons by S2 and S3 (as to the conditions to be satisfied, see the preceding section).

At this stage, the order of the alternate options is done because one of them outranks the others and therefore

Table 7 Cardinal Values of the verbal terms used by the experts according to Chen S.J., Hwang C.L. and Hwang P.H. (1992).

Verbal Terms	Evaluation Scales							
	8	7	6	5	4	3	2	1
None	0.05							
Very Low	0.14	0.08	0.09	0.08		0.09		
Low to Very Low	0.25	0.09						
Low	0.33	0.25	0.23	0.25	0.12	0.28	0.17	
Fairly Low				0.42				
More or Less Low			0.36					
Medium Low	0.41	0.37			0.30			
Medium	0.50	0.50	0.50			0.50	0.50	0.50
Medium High	0.57	0.63			0.70			
More or Less High			0.64					
Fairly High				0.58				
High	0.67	0.75	0.77	0.75	0.88	0.72	0.83	0.75
High to Very High	0.75	0.88						
Very High	0.86	0.92	0.91	0.92		0.91		
Excellent	0.95							

Table 8 Preference matrix with the raw data and the weights assigned to the criteria.

Alternative scenarios	Hydraulic regime and water biology			Fauna			Flora		Social-economic aspects		Landscape
	Flood flows regime	Hydrogeological stability	Water quality	Birds	Mammalia	Invertebrates	Weeds	Coastal psammophile vegetation	Labour requirement (000 working days)	Agricultural Added Value (000 ECU)	Visual quality
	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)
Scenario 1	75	55	26	51	60	23	64	24	378	23,491	49
Scenario 2	76	60	40	58	61	43	70	26	380	23,007	52
Scenario 3	80	70	48	64	66	55	68	28	369	22,401	65
Weights	0.09	0.08	0.12	0.08	0.04	0.06	0.06	0.04	0.14	0.14	0.15

Table 9 Preference matrix with the standardized data and the weights assigned to the criteria.

Alternative scenarios	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)
Scenario 1	0.94	0.78	0.54	0.80	0.91	0.42	0.91	0.86	0.99	1.00	0.75
Scenario 2	0.95	0.86	0.83	0.91	0.92	0.78	1.00	0.93	1.00	0.98	0.80
Scenario 3	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.97	0.95	1.00
Weights	0.09	0.08	0.12	0.08	0.04	0.06	0.06	0.04	0.14	0.14	0.15

Concordance threshold values: C+ =0.60; Co =0.55; C- =0.50.
Discordance threshold values: D1 (strong) =0.20; D2 (weak) =0.40.

Table 10 Weights Ratio (W+/W-) Matrix.

	Scenario 1	Scenario 2	Scenario 3
Scenario 1	-	0.163	0.389
Scenario 2	6.143	-	0.515
Scenario 3	2.571	1.941	-

Table 11 Concordance Matrix.

	Scenario 1	Scenario 2	Scenario 3
Scenario 1	-	0.140	0.280
Scenario 2	0.860	-	0.340
Scenario 3	0.720	0.660	-

Table 12 Discordance Matrix.

	Scenario 1	Scenario 2	Scenario 3
Scenario 1	-	0.970	0.950
Scenario 2	0.030	-	0.900
Scenario 3	0.050	0.100	-

Table 13 Overall concordance and discordance indices.

Scenario	Overall concordance index	Overall discordance index
1	-1.16	1.84
2	0.40	-0.14
3	0.76	-1.70

it has not been necessary to go on relaxing the starting thresholds (choosing higher values for the discordance index thresholds and lower ones for the concordance index thresholds).

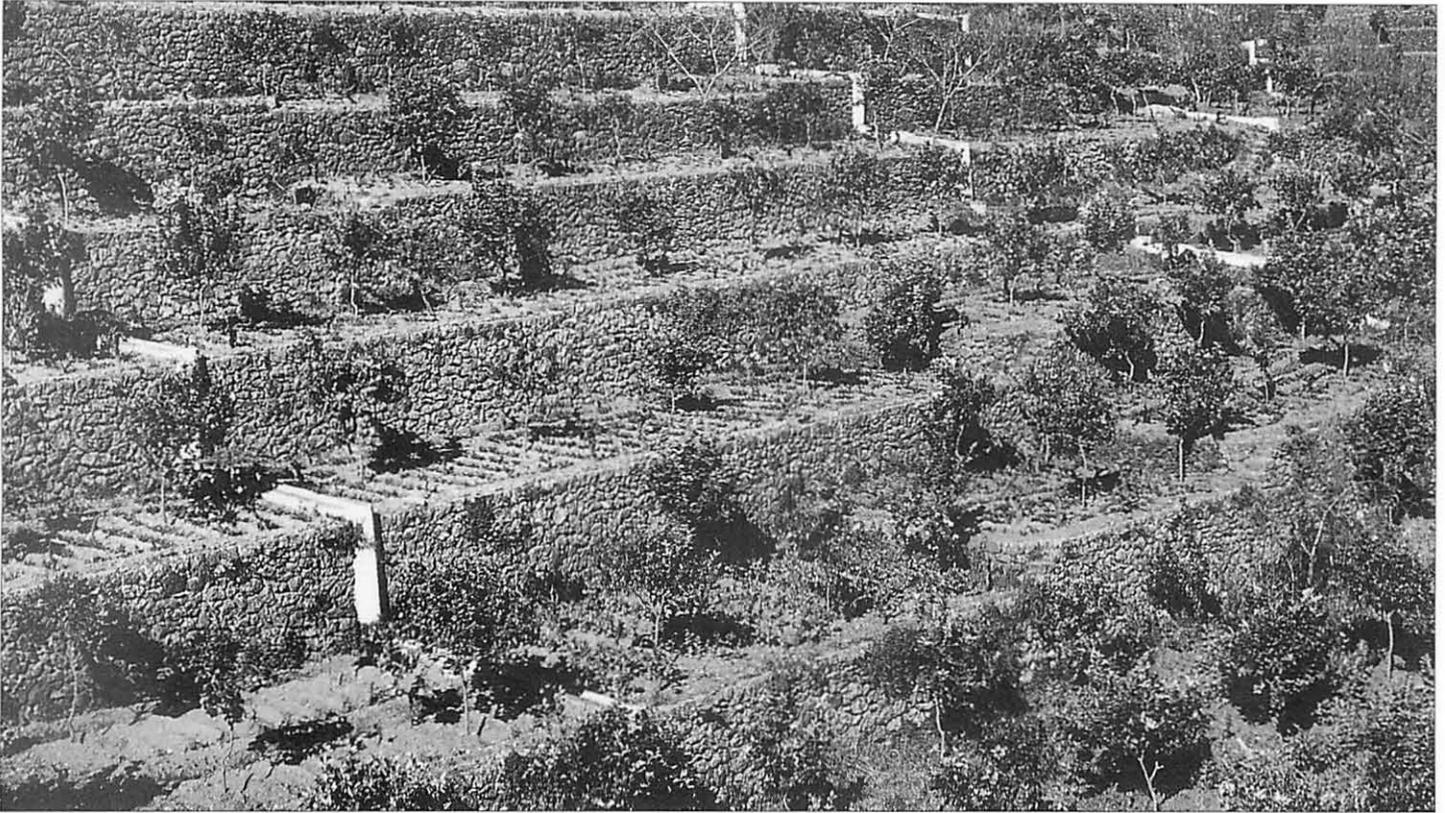
In order to verify the robustness of the results obtained, a different methodology (related to the analysis of concordance) for ordering alternate solutions has been carried out, based substantially on a pair of indices, called "absolute" or "overall" concordance and discordance indices.

The procedure that allows to calculate them is reported in the preceding section of the paper and their values are illustrated in **table 13**. On the ground of these indices, both the orders confirm that Scenario 3 seems to be the best solution, followed by S2 and S1.

A further test for sensitivity has been implemented, producing some changes in the composition of the weights assigned to the criteria by the experts. The results of several trials strengthen the same order come out from the analysis, because the ordering of the three alternatives has been overturned only when the weights assigned to the social-economic criteria were equal to 0.84, out of the total sum 1.00.

CONCLUSIONS

The results of the research carried out by means of a multicriteria analysis method, ELECTRE II, appear to prove clearly the effectiveness of CAP accompanying measures about environmental protection and the overall improvement in the quality standards of life, through a riconversion of intensive agricultural systems and the cultural practices related to eco-compatible agriculture.



Nevertheless at least two drawbacks are immediately noticeable: the first concerning the nature of data, the latter the long-term assumptions about the development of the economic system. As for information gathering, the data regarding environmental indicators derive from qualitative estimates made by experts, even as to Scenario 1 and, as a consequence of it, a situation of strong uncertainty about their complete reliability turns out. It is noteworthy to point out that lack of official environmental statistics (due to the difficulty in monitoring natural resources and pollution) is still widespread in Italy and represents a remarkable problem for land planning. The second inconvenience derives from the deliberate choice of the authors not to take into account the long run evolution of some economic variables like prices, production costs, technological innovation, etc.. In fact this research, which employs a methodology capable of providing the decision-maker with useful suggestions, aims at being just a preliminary approach to the impact assessment of the current EU agricultural policies for the environmental protection of traditional rural areas. ●

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